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EXTENDED BANDWIDTH VTS-5753B1 COUPLED CAVITY TRAVELING WAVE TUB--ETC(U)
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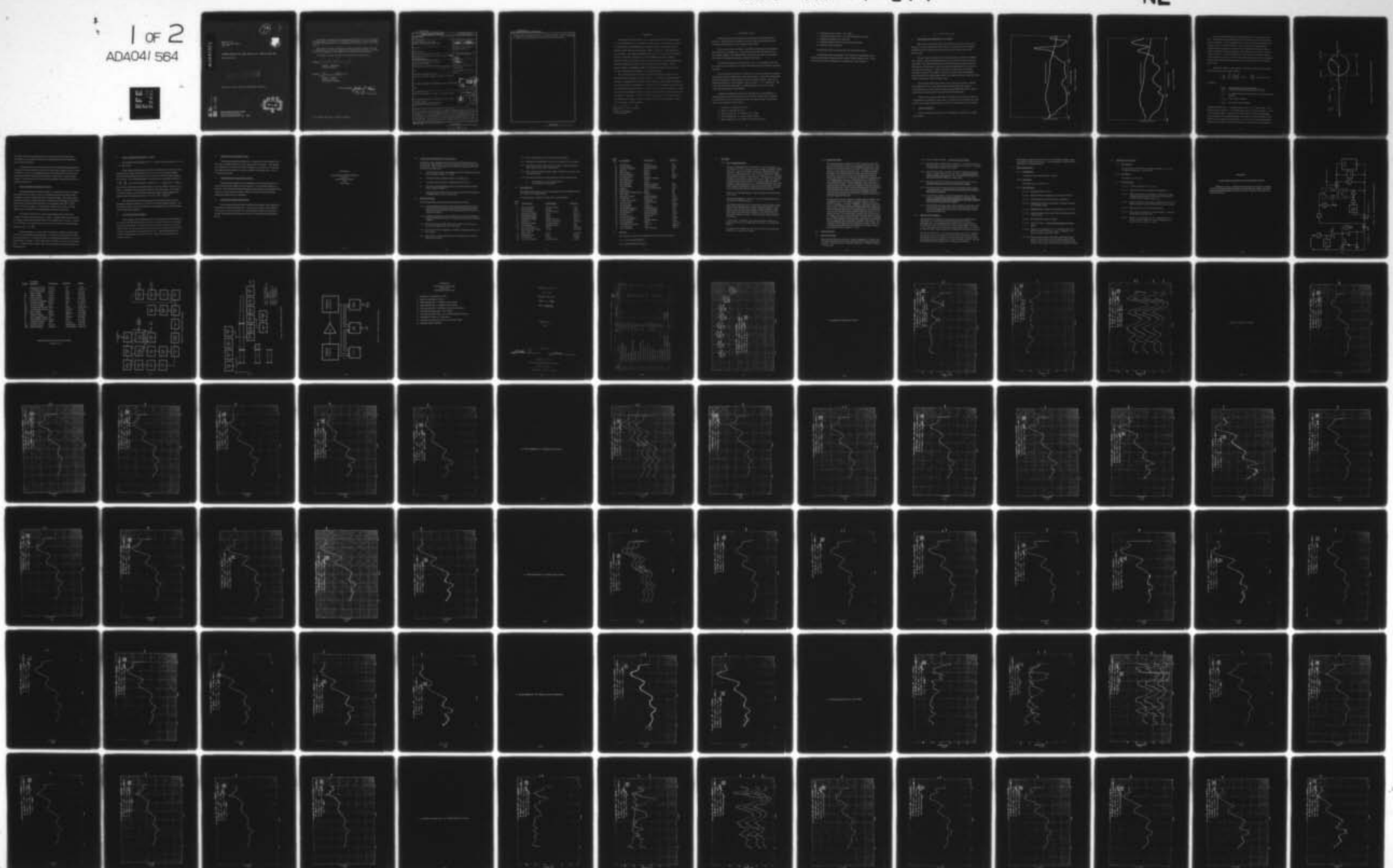

RADC-TR-77-174
Final Technical Report
June 1977

EXTENDED BANDWIDTH VTS-5753B1 COUPLED CAVITY TRAVELING WAVE TUBE

Varian Associates

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ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, New York 13441

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This report has been reviewed and is approved for publication.

APPROVED: Joseph J. Polniaszek Jr.

JOSEPH J. POLNIASZEK
Project Engineer

APPROVED: Joseph L. Ryerson

JOSEPH L. RYERSON
Technical Director
Surveillance Division

FOR THE COMMANDER: John P. Huss

JOHN P. HUSS
Acting Chief, Plans Office

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objective of this effort was to establish sufficient data on the VTS-5753 family of coupled cavity traveling wave tubes to enable evaluation of the tube's capabilities in a tactical, ECCM environment. This was accomplished by the development of an extended bandwidth tube capable of transmitting sophisticated radar waveforms that have low ECM susceptibility and extensive testing of the resultant tube. This project was highly successful in both respects. A tube of the VTS5753 family was developed, the VTS5753B1, that has a 200 MHz wider

406552

bandwidth than the previous version of the tube. Secondly, the testing program has supplied data invaluable to system designers/analysts that will allow them to incorporate tube nonlinearities into the overall system design.

EVALUATION

The Varian VTS-5753 coupled cavity traveling wave tube has been limited to a 12% bandwidth due to a narrowband window design. This effort was aimed at extending the tube bandwidth and tabulating data concerning the tube's operation under varying and sometimes adverse conditions. Both goals have been attained. The extended bandwidth tube has a useful electronic bandwidth of 18% and extensive evaluation over this bandwidth has been attained. Conditions such as beam supply pushing, long line effects and mismatched lines have been simulated and data has been collected and correlated. These results indicate a remarkable amount of amplitude and phase linearity over the band considering the absence of an input equalizer.

The conclusions and test results obtained through this effort will be incorporated into various Air Force projects. For example, system engineers now have a tabulated set of characteristics that will allow them to determine the radar amplifier's deviations from linear, and to determine the effects upon the sophisticated ECCM waveforms of today's "state of the art" systems. Further research and development can now be placed upon more refined tube characteristic measurements techniques. Finally, the data generated can be integrated into the RADSIM radar simulator software package to refine the transmitter complex for preliminary system evaluation.

Joseph J. Polniaszek Jr.

JOSEPH J. POLNIASZEK
Project Engineer

I. INTRODUCTION

A general discussion of the program is presented in the Technical Report Summary. That document is considered to be part of this report and the data and comments presented therein are not repeated in this report.

The formal test data were taken in accordance with the approved Acceptance Test Procedure (see Appendix A). At the request of the RADC representative who witnessed the testing, some additional data were taken for the sake of completeness and in order to facilitate the computer simulation of the tube.

The official test data were limited to the 3.0 to 3.7 GHz frequency range due to a resonance in the collector at 2.950 GHz which interfered with the phase-measuring equipment.

Most of the data were taken at 4% duty factor in order to complete the required measurements without risking failure of the output window. The tube was subsequently tested to the required 8% duty near the end of the acceptance testing. There was no measurable difference in the amplitude or phase at either 4% or 8% duty factor. This is not surprising, since these tubes are routinely tested to 12 or even 15% duty factor without amplitude or phase changes.

Appendix B containing the test data is large because, in many instances, a separate graph was made for each drive level in order to simplify future computer processing of the data. It is organized into the following ten groups, each dealing with a major parameter and/or variable:

1. Amplitude as a function of rf drive
2. Phase as a function of rf drive
3. Phase pushing with ±1% change in beam voltage
4. Phase pushing with ±3% change in beam current
5. Phase pushing with ±1 kV change in collector depression

6. Amplitude and phase with a 1.25:1 VSWR
7. Amplitude and phase with a 1.25:1 VSWR shifted by $\lambda/2$ phase
8. Amplitude and phase at 8% duty factor
9. Amplitude and phase at 300 microsecond pulse length
10. Intrapulse phase modulation

The test parameters are listed in the Test Performance Sheet.

A preliminary step in the testing is the calorimetric measurement of the efficiency-bandwidth with optimum drive at each 100 MHz frequency point. These data are given in the first graph and in replotted form in the summary.

II. TEST RESULTS

A. AMPLITUDE AS A FUNCTION OF RF DRIVE

The nominal rf drive selected for the testing was one watt, with two watts shown as +3 dB, one-half watt as minus 3 dB, etc. Optimum drive was actually between one and two watts and was used in the maximal flatness curves in the summary data.

The gain ripple is unusual for this tube type since it increased in amplitude with frequency. Several measurements were made to determine the origin of the gain ripple. The output hot match was measured by driving the output circuit from the output end with the beam on and observing the reflected power as compared to a short circuit (see Figure 1). This is a measure of regeneration in the output circuit due to internal mismatches. No direct correlation could be established between the output hot-match ripple and the small-signal gain ripple except that where the hot match is good, the least ripple occurs.

The hot match of the input circuit was also measured in order to establish the contribution, if any, of the input circuit to the gain ripple (see Figure 2). Comparison with the small-signal gain ripple again indicated that the gain ripple is least at the low end of the band, where the hot match is quite good.

Therefore, by process of elimination, the center drive circuit is suspected of being the main contributor to gain ripple. Measurement of hot match in the center circuit is not possible because the sever loads are an integral part of the assembly.

B. PHASE LINEARITY

The phase deviation from linear was investigated as a function of a variety of parameters.

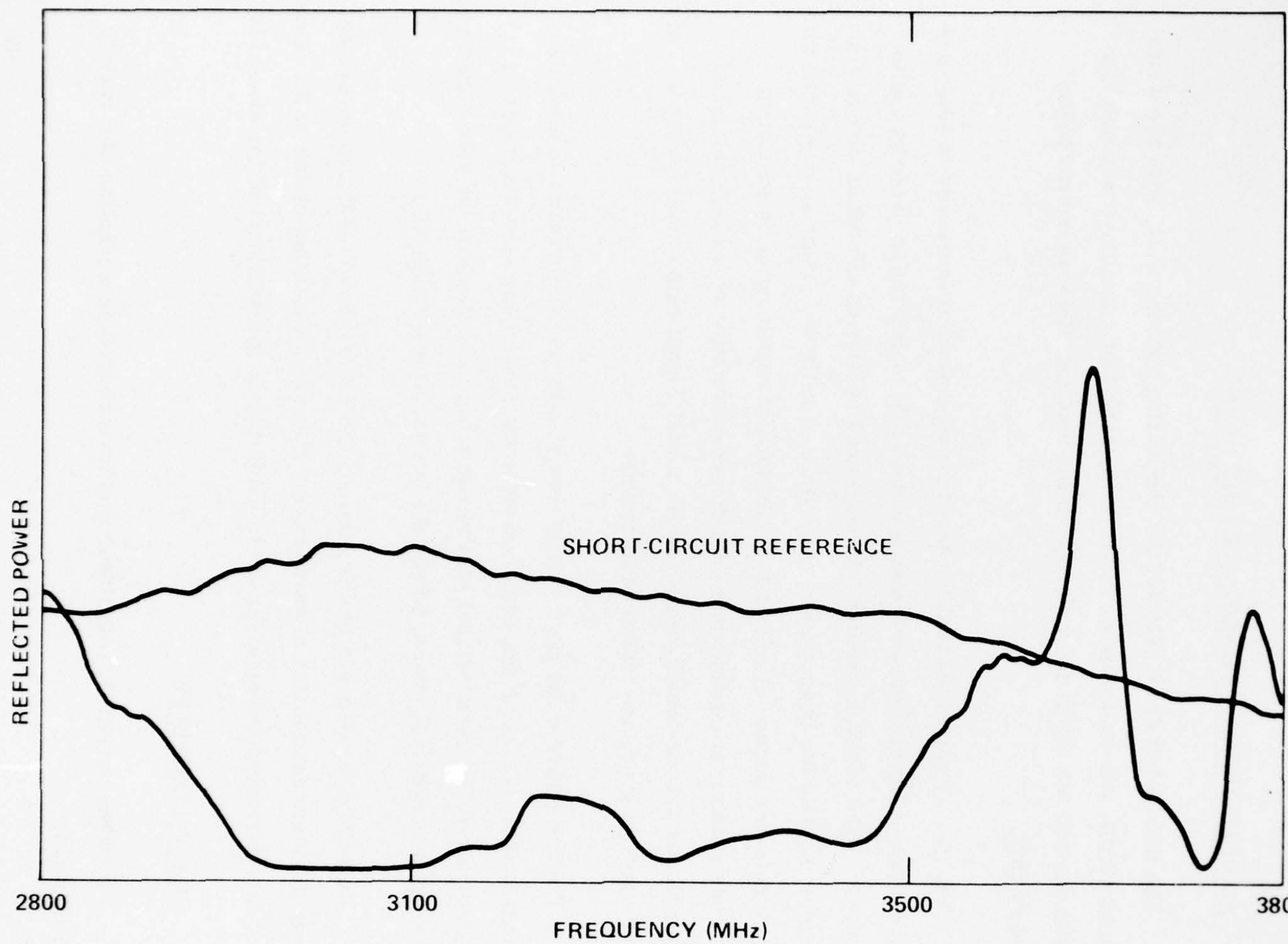


Figure 1. Hot Output VSWR

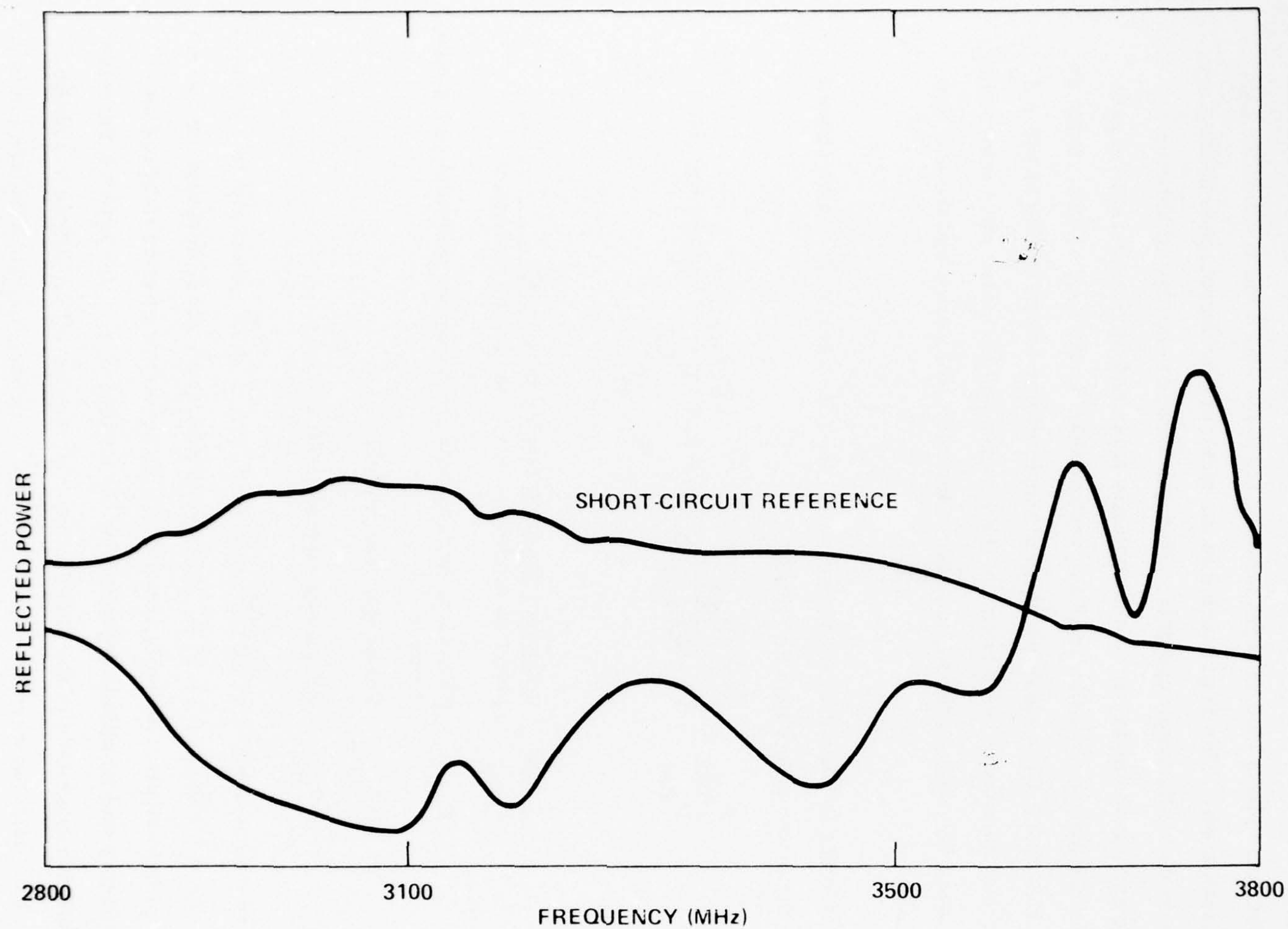


Figure 2. Hot Input VSWR

The correlation between phase ripple and gain ripple was evident from the data. The phase peaks (and valleys) occur at the point where the slope of the gain ripple is maximum. This is presented in the summary by superimposing the phase deviation on the -3 dB amplitude data. This quadrature relationship between amplitude and phase ripple can be theoretically explained by considering the gain ripple as a frequency-sensitive feedback vector added to the normal gain vector as shown in Figure 3. If we consider the gain ripple vector to be rotating at the end of the nominal gain vector as a result of the forward and backward wave interaction, then the phase deviation is the angle between the resultant vector and the average phase vector.

Referring to Figure 3, the magnitude of the phase deviation can be related to that of the power gain ripple as follows:

$$\frac{P_{max}}{P_{min}} = \left(\frac{1 + \Delta V_{RF}}{1 - \Delta V_{RF}}\right)^2 \quad \text{and } \Delta\phi \simeq \frac{\Delta V_{RF}}{V_{RF}} \quad \text{radians for small}$$

variations.

$\frac{P_{max}}{P_{min}}$ = $\frac{\text{maximum power in rippled response}}{\text{power at minimum next to the power maximum}}$

V_{RF} = RF voltage halfway between maximum and minimum peaks in power

$\Delta\phi_{max}$ = Phase ripple amplitude

ΔV_{RF} = RF voltage ripple amplitude

Using these expressions, a ±1 dB gain ripple will give a ±6.9° phase ripple. From the tube data at midband, a ±1.65 dB gain ripple yields ±8° phase deviation or ±5° for a 1 dB amplitude ripple. Actually, each of the three sections has an independent ripple frequency and amplitude depending on the number of cavities between the mismatches and the magnitude of the standing wave so the overall amplitude and phase ripple can be a complex waveform over the band. Compression and deceleration in

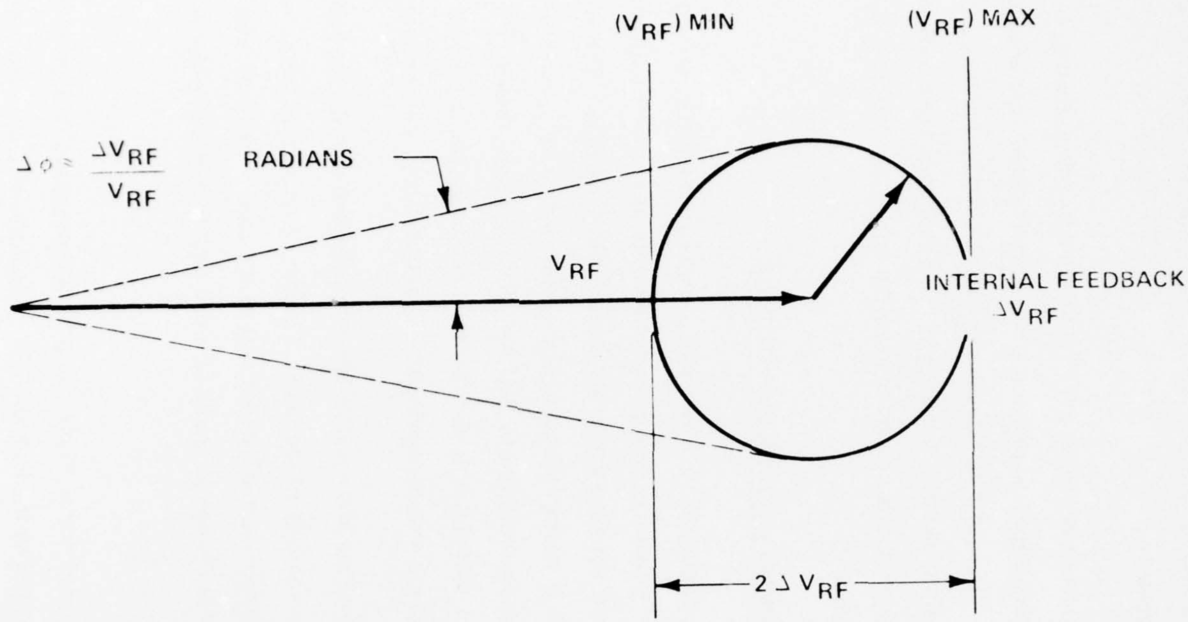


Figure 3. Vector Diagram, Gain-Phase Relationship

the output circuit also complicate the phase ripple to gain ripple relationship. Nevertheless, the simplified model gives reasonable agreement and explains the gain-to-phase quadrature.

The phase deviation can be greatly reduced by predistorting (equalizing) the amplitude of the drive signal to provide a flat small-signal response at the -3 dB and -6 dB level. In practice, the flattest phase is achieved by further trimming of the drive amplitude while observing the swept phase response from a dynamic phase analyzer. For this reason it is best to have the equalizer matched to each TWT by the tube manufacturer.

C. PHASE PUSHING WITH BEAM VOLTAGE

The phase pushing due to beam voltage was measured to be minus 28 degrees per percent of beam voltage. This is in reasonable agreement with theory based on change in the wave velocity due to the accelerating voltage. The voltage change represents a change in energy which bears a square root relationship to the electron velocity which is approximately one half for small changes, hence $\frac{\Delta v}{v} = \frac{1}{2} \frac{\Delta V}{V}$, where V is the beam voltage, v is the electron velocity, and ΔV and Δv are the changes in beam voltage and corresponding beam velocity, respectively.

The velocity of the hot wave is intermediate between the velocity of the circuit wave and the velocity of the beam. Hence, a change in beam velocity results in a change in phase approximately half that of the change in beam velocity. Actually, from TWT theory, the change in phase is more nearly 0.6 the beam velocity change. Therefore, $\frac{\Delta \phi}{\phi} = 0.3 \frac{\Delta V}{V}$.

The phase change for a minus one percent change in voltage is approximately 0.003 times the total phase through the tube. At midband, the phase shift per cavity is approximately 270° ; and with 29 cavities, the phase change calculates to -23.5° per percent change in voltage. From the tube data at midband, a value of -25° is obtained with a +1% change in beam voltage. This is in good agreement with the approximate calculated value.

D. PHASE PUSHING WITH BEAM CURRENT

The measured phase change with a $\pm 3.3\%$ change in beam current was $\pm 16°$, or $\approx 4.5°$ per percent.

Phase change with beam current is due to the change in wave velocity, with a change in beam voltage at the center of the beam due to space-charge potential depression and the change of the slow space-charge wave velocity with a change in beam current. The relationship between microperveance and potential depression is $\frac{\Delta V}{V} = \frac{\mu K}{30}$, since microperveance is defined as $\mu K = \frac{I}{V\,3/2}$; then, a change in beam current represents an equivalent change in perveance where V and ΔV are as before, I is the beam current, and μK is the beam microperveance. The change in slow space-charge wave velocity has approximately three times the effect as the change in the voltage depression value. Therefore, $\frac{\Delta \phi}{\Delta} \simeq \left(\frac{0.3}{7.5}\right) \frac{\Delta I}{I}$.

This implies that the phase pushing per percent change in beam current (perveance) should be a factor of 7.5 less than the voltage pushing sensitivity. The data show the factor to be 6.2 less than the voltage pushing factor in percent change, which is quite good agreement.

E. COLLECTOR PHASE PUSHING

Phase pushing with collector depression is on the order of a few degrees per kV as long as the depression is not increased to the point that there is a substantial increase in body current. The body current is the result of slow electrons being reflected back down the beam tunnel and subsequently lowering the forward electron velocity by increasing the space-charge depression. The phase pushing due to collector voltage changes is therefore a result of this second-order effect of the returned electrons.

F. MISMATCH IN THE DUMMY LOAD

The amplitude and phase change due to a standing wave in the output load is due to the resultant standing wave in the output section of the tube. If the tube has well matched sever loads and no internal reflections as evidenced by a reasonable hot output match, the effect of a modest load VSWR will be quite small – as was measured for this tube.

G. INCREASED DUTY AND PULSE LENGTH

The phase and amplitude were investigated at an increased duty factor of 8% and an increased pulse length of 300 microseconds. No measurable change was observed. These tube types using the standard output window have subsequently been tested to 15% duty factor and at pulse lengths up to 1000 microseconds without significant change in phase or amplitude.

H. INTRAPULSE PHASE MODULATION

This measurement is primarily an addition of the quality of the regulation on the electrode voltages during the pulse. The data from the three pulse lengths of 50, 100 and 300 microseconds show very good intrapulse regulation and absence of any tube-contributed phase change due to thermal or space-charge neutralization effects.

APPENDIX A

ACCEPTANCE TEST PROCEDURE
FOR THE
125 kW PULSE S-BAND
TWT
VTS-5753B1

1.0 Calibration Measurement Accuracy Summary

Calibration of test equipment will be done by the Standards Laboratory of the Palo Alto Tube Division of Varian in conformance with QAOP and to the specification. These calibrations will be given below unless specified differently in individual tests.

a. All directional couplers and attenuators used for measuring rf power will be calibrated within $\pm$ 1% in dB.

b. All meters will be calibrated within $\pm$ 2% of full scale.

c. All gauges and scopes will be calibrated within 1% to 3%.

d. All current viewing transformers and associated viewing circuitry will be calibrated within 3%.

e. The digital beam voltage meter and resistor chain will be calibrated on absolute basis to $\pm$ 0.2% of full scale.

1.1 Safety Precautions

The following safety devices and procedures shall be provided:

1.1.1 All immediately involved personnel shall be informed of the nature and position of the test setup, specifically the high voltage hazard with the depressed collector mode of operation and the relevant precautions to be taken.

1.1.2 Applicable equipment will have shorting devices to insure discharge of high voltage storage capacitors when any terminal is in an exposed condition.

1.1.3 High-voltage-tested rubber mats will be utilized at the test set to decrease the chances of an electrical shock.

1.1.4 First Aid and medical supplies, to include a respiratory device, will be available.

1.1.5 Signs such as: Danger High Voltage, Emergency Off, etc. will be appropriately placed.

1.1.6 Extra safety glasses will be available when required.

1.1.7 Adequate fire extinguishers (CO_2 or dry chemical) will be available.

1.1.8 Two people will be present at all times when working on equipment which could present a high voltage hazard.

1.1.9 There will be a safety emergency light, to light the area in the event of a power failure.

1.1.10 The test set supervisor shall regularly check the following items:

1. No HV leads are in an exposed position.
2. HV interlocks are operational.

1.2 Instrumentation

The numbers in the blocks of the test setup diagrams refer to the block number column in the equipment list.

The following list of equipment will be used or its equivalent.

Block No.	Nomenclature	Manufacturer	Model No.
1	Sweep Oscillator	Hewlett Packard	692D
2	TWT Amplifier	Varian	1350G
3	Low Pass Filter	Hewlett Packard	360D
4	Directional Coupler	Narda	3043-30
5	Directional Coupler	Narda	3043-20
6	Directional Coupler	Narda	3043-10
7	Variable Attenuator	Hewlett Packard	S382B
8	Circulator	Western Microwave	CTS-2021
9	Thermistor Mount	Hewlett Packard	478A
10	Power Bridge	Hewlett Packard	431B
11	Arc Viewing Port	Varian	VES-8470
12	Dual Directional Coupler Nom. 50/50 dB	Varian	VA-136K
13	Water Load	Varian	L284DA2
14	Frequency Meter	FXR	N-410A
15	Arc Detector	Varian	V-9000
16	Coax to WG Adaptor	Hewlett Packard	S281B

Block No.	Nomenclature	Manufacturer	Model No.
17	Oscilloscope	Tektronix	545
18	Crystal Detector	Hewlett Packard	423A
19	Variable Attenuator	Hewlett Packard	S382B
20	Resolver	Wiltron	311
21	Pulse Adapter	Wiltron	306
22	Network Analyzer	Wiltron	310B
23	Dc Power Supply	Varian	Special
24	Dc Voltmeter	Sensitive Research	UEP
25	Blank Waveguide	Varian	
26	Phase Sampler	Varian	
27	Kilo Voltmeter	Sensitive Research	ESH
28	Coax Attenuator	Weinschel Engr.	210-10
29	Isolator	E and M Laboratories	519P
30	Beam Scale	Homs	105
31	Differential Pressure Gauge	Barton	227
32	Flow Meter	S and K	40J
34	Spectrum Analyzer	Hewlett Packard	8555A
35	Preselector	Hewlett Packard	8445A
36	50 Ohm Termination	Weinschel	535MN
40	X-Y Recorder	Hewlett Packard	7030
41	Reflectometer	Varian	Special
42	X-ray Monitor	Victoreen	440RF
43	RF Radiation Monitor	Hewlett Packard	8555
44	Microwave Switch	Hewlett Packard	3505
45	Pin Modulator	Hewlett Packard	8732B
46	Modulator	Hewlett Packard	8403A
47	Pulse Generator	Rutherford	B-14
48	50 Ohm Termination	Narda	369NM
49	Crystal Detector	Hewlett Packard	420A
50	Coax Attenuator	Narda	757C-20
51	Waveguide Termination	Americon	9099-5102
53	Coax DC Block	FXR	HR52N
54	Coax Attenuator	Weinschel Engr.	530A-20

1.3 Facilities

The facilities necessary for conducting tests in this procedure include:

1.3.1 Power Supply/Modulator

1.3.2 Recirculated Water System

1.4 Test Setup

1.4.1 Power Supply/Modulator

The power supply/modulator configuration is shown in Figure 2.1A. It consists of a 45 kV, 10 ampere, power supply, continuously variable from zero. Two series regulators drop and regulate the beam and collector voltages to the TWT. The collector regulator and supply has a rating of 20 amperes peak and is insulated for 50 kV. The beam regulator has a rating of 5 amperes peak. The metering is described in Figure 2.1B with the ranges and accuracies listed. The grid bias voltage and the grid pulse voltage are set using calibrated digital voltmeters with an accuracy of 1%. Additional monitoring is provided by pulse current transformers directly on the TWT leads. The peak body current is monitored by a pulse transformer that views the difference between the collector current and the beam current.

There are two filament supplies. The AC supply will be used for all of the tests.

The filament supplies are rated for 0 to 15 volts (minimum) and are floating at the cathode potential.

An electronic crowbar system is provided to remove the high voltage within 10 microseconds after a trigger input (waveguide arc, peak beam current, and peak body current). The beam supply is interlocked to remove and/or prevent application/re-application of the high voltage for the following conditions: external interlock open, electronic crowbar not ready, overcurrent relays not reset and low bias voltage.

A high voltage arc indicator is provided to indicate cathode arcs. Sensing is provided in the cathode lead by means of a current transformer.

All controls are insulated for safe, direct contact by personnel and included is an emergency off switch.

1.4.2 General RF Set-up

The equipment shown in Figures 2.2A and 2.2B is the general RF test set-up and will be used for the majority of the RF tests. When required, the general set-up will be modified by additions or deletions to perform specific tests on the TWT. Changes to the general set-up are shown under the specific tests. The changes describe the purpose of the modification and do not necessarily repeat the detail given in the general set-up. The equipment descriptions indicate the purpose of the component and equivalent components may be substituted unless it forms a functional part of a calibrated section. Substitutions of equivalent components will be noted and reported in the test report. The RF calibration will be contained in a calibration book and the equipment identified by calibration stickers. The calibrations and control of the test equipment will be performed by Instrument Services under the direction of Quality Assurance. Controls and procedures for calibration are specified in Quality Assurance Operating Procedure 87-800-154 and Instrument Services Operation Manual 87-800-153.

The general RF set-up consists of a sweeper and RF amplifier with a feedback loop via coax coupler and power bridge to provide a leveled RF source. A precision attenuator is used to set the drive level as monitored by a coupler, attenuator, thermistor mount, and power meter. The input waveguide section that forms the functional part of measuring drive power is calibrated intact. The output line consists of a waveguide dual directional coupler followed by a 1.05:1 (max) waterload. The output coupler provides two samples of the RF output. One arm is terminated in a thermistor and power bridge for a relative indication of power output. The other arm is terminated in a crystal detector which allows the output pulse to be observed on an oscilloscope and the frequency checked by a wavemeter. The mismatch and the output line are calibrated for VSWR. Power out is measured calorimetrically and all other power output indicators are referenced to the calorimetric value.

2.0 Test Procedures

2.1 Turn-on Procedure

Insure that coolant flow connections, cathode, heater grid, collector, solenoid and body electrical connections and the VacIon(R) pump connection are all made. Connect the basic rf input and output lines as shown by Figures 2.2A and 2.2B.

2.1.1 Check coolant resistivity. RECORD ON DATA SHEET.

2.1.2 Set liquid and air coolant flow to rated flow. Check inlet liquid coolant temperature to insure that it is between 15° and 40° C. RECORD FLOW RATES ON TEST DATA SHEET.

2.1.3 Turn on VacIon pump, solenoid, and heater voltages to nameplate values. Set bias voltage to -500V to -700V. RECORD BIAS VOLTAGE ON TEST DATA SHEET. Observe that the VacIon pump voltage and current are within the normal range.

2.1.4 Set beam and collector voltages to previously determined values. RECORD THESE VALUES ON THE TEST DATA SHEET.

2.1.5 After five minutes of heater operation, final adjust heater voltage to nameplate value. RECORD HEATER VOLTAGE AND CURRENT ON TEST DATA SHEET.

2.1.6 Set grid drive voltage to previously determined value and start pulsing. RECORD GRID PULSE CURRENT, VOLTAGE, PEAK CATHODE, BODY, COLLECTOR CURRENTS, SOLENOID CURRENT AND VOLTAGE ON TEST DATA SHEET.

2.1.7 Verify that the operating voltages and currents are within the limits as given in the Test Data Sheet. These values define the standard operating conditions of the tube and are set for all tests except as noted in individual tests.

2.2 Standard Test Conditions

The standard test voltages and currents are as determined (defined) in Paragraph 2.1. The normal video pulse length is 15 to 310 μsec measured at the 70% amplitude points and the normal rf pulse length is 10 to 300 μsec. The rise and fall times of the rf pulse shall be less than 2 μsec. The flatness of the grid pulse voltage shall be within $\pm$ 2 V across the specified pulse length except for the leading and trailing edge transients.

Normal video duty cycle is 9% and normal rf duty cycle is 8%*. Optimum drive power is set to a constant level between the limits of 0 and 12.5 W. The optimum drive power shall be determined prior to acceptance testing and shall become the nameplate value. The load VSWR is 1.05:1. The output waveguide shall be pressurized at 5 psig with dry nitrogen.

*Preliminary testing will be performed at 5% video and 4% rf duty to minimize window - failure during testing. Limited testing at 8% duty will follow completion of the required testing.

3.1 Phase Linearity Test

3.1.1 Test Objective

To measure swept frequency phase response.

3.1.2 Test Set-up

Per Figure 2.2A, 2.2B and 2.2C.

3.1.3 Test Procedure

3.1.3.1 Maximum VSWR of 1.05:1.

3.1.3.2 Operate TWT per Paragraph 2.1 except use CW drive.

3.1.3.3 Calibrate phase detection system per Appendix A,

3.1.3.4 Adjust phase detector and recorder for nominal response over frequency range.

3.1.3.5 Adjust RF drive frequency to sweep from 2.9 to 3.7 GHz.

3.1.3.6 Adjust recorder axis to achieve full scale deflection from 2.9 to 3.7 GHz.

3.1.3.7 Set sweep time to 100-10 seconds.

3.1.3.8 Activate recorder. Label and attach graph to test data sheet.

3.1.3.9 Repeat 3.1.4.5 through 3.1.4.8. Adjust RF drive to + 3 dB and -12 dB in 3 dB steps. Note: Limitations in RF drive may limit overdrive to +3 dB.

3.1.3.10 Phase measurements at short pulse length approaching 10 μsec will be a goal, because of phase equipment limitations. Phase is normally measured with rf pulse width of 50 μsec and a phase sample of 25 μsec within the rf pulse.

4.1 Amplitude Linearity Test

4.1.1 Test Objective

To measure the swept frequency amplitude response of the tube RF output operating into a matched load.

4.1.3 Test Set-up

Per Figure 2.2A and 2.2B.

4.1.4 Test Procedure

4.1.4.1 Maximum VSWR of 1.05:1 or less.

4.1.4.2 Operate the TWT per conditions of Paragraph 2.1.

4.1.4.3 Adjust rf attenuators preceding the rf input and rf output monitoring thermistors, to achieve on scale deflection on power meters throughout sweep F_B.

4.1.4.4 Adjust rf frequency sweep interval starting at 2.9 GHz and adjust recorder X-axis for full deflection over this range.

4.1.4.5 Step sweep time to 100-10 seconds nominal.

4.1.4.6 Plot a graph of output power versus frequency. Label and attach graph to test data sheet.

4.1.4.7 Repeat 4.1.4.2 through 4.1.4.6. Adjust rf drive to +3 dB and -12 dB in 3 dB steps. Note: Limitations in rf drive may limit overdrive to +3 dB.

APPENDIX A

CALIBRATION OF WILTRON PHASE MEASURING SYSTEM

Methods for set-up, calibration and operation of the system is contained in Wiltron Company Instruction Manual for Model 306 pulse adapter and Wiltron Company Instruction Manual for Model 310B network analyzer with Model 311 series rf resolvers.

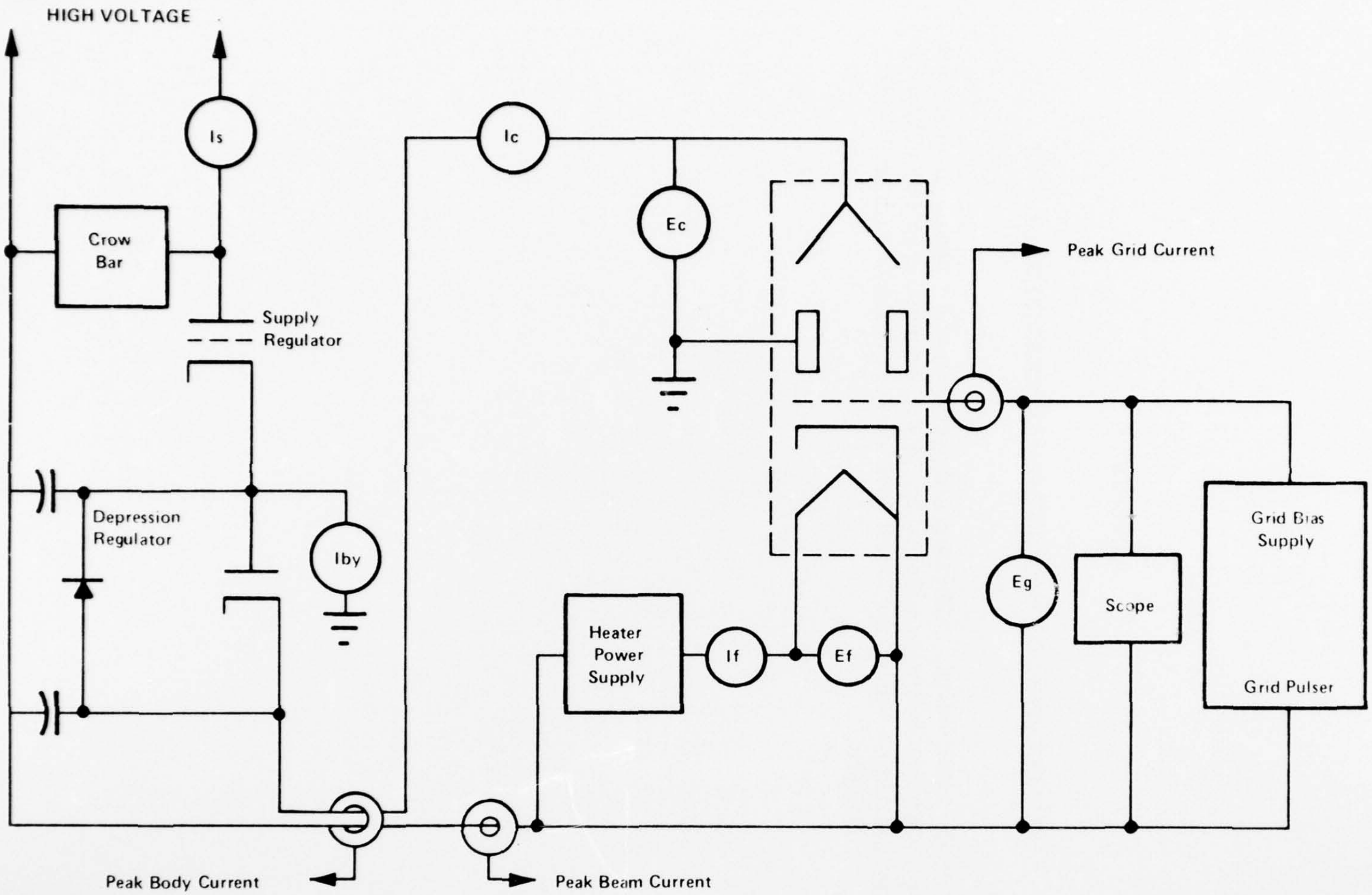


Figure 2.1A. Power Supply/Modulator Configuration

Symbol	Parameter Measured	Manufacturer	Model No.	Range
	Peak Body Current	Pearson	2100	1 V/1A
	Peak Beam Current	Pearson	325	0.25 V/1 A
	Peak Grid Current	Pearson	2100	1 V/1 A
Ef	Heater Voltage	Weston	1941T	0-30 Vdc
Ef	Heater Voltage	Weston	1944	0-15 Vac
If	Heater Current	Weston	1944	0-30 Aac
If	Heater Current	Weston	1941T	0-20 Adc
Eg	Grid Pulse Amplitude	Weston	1294	0-1.99 kV
Eg	Grid Bias Voltage	Weston	1294	0-1.99 kV
Eg	Grid Bias Voltage	API	461	0-1.5 kV
Iby	Average Body Current	Weston	1951T	0-300 mAdc
Iby	Average Body Current	API	428-1223	0-1 Adc
Ek	Beam Voltage	Weston	1941T	0-50 kVdc
Ek	Beam Voltage	Beede	MR24-05	0-50 kVdc
Ec	Collector Voltage	Weston	1941T	0-25 kVdc
Is	Power Supply Current	API	428-1223	0-10 Adc
Is	Power Supply Current	Weston	1941T	0-10 Adc
Ic	Collector Current	Weston	1941T	0-10 Adc
Ic	Collector Current	API	428-1223	0-10 Adc
Isol	Solenoid Current	Sorensen	Power Supply	0-50 Adc
Esol	Solenoid Voltage	Sorensen	Power Supply	0-200 Vdc

POWER SUPPLY/MODULATOR METERING

FIGURE 2.1B

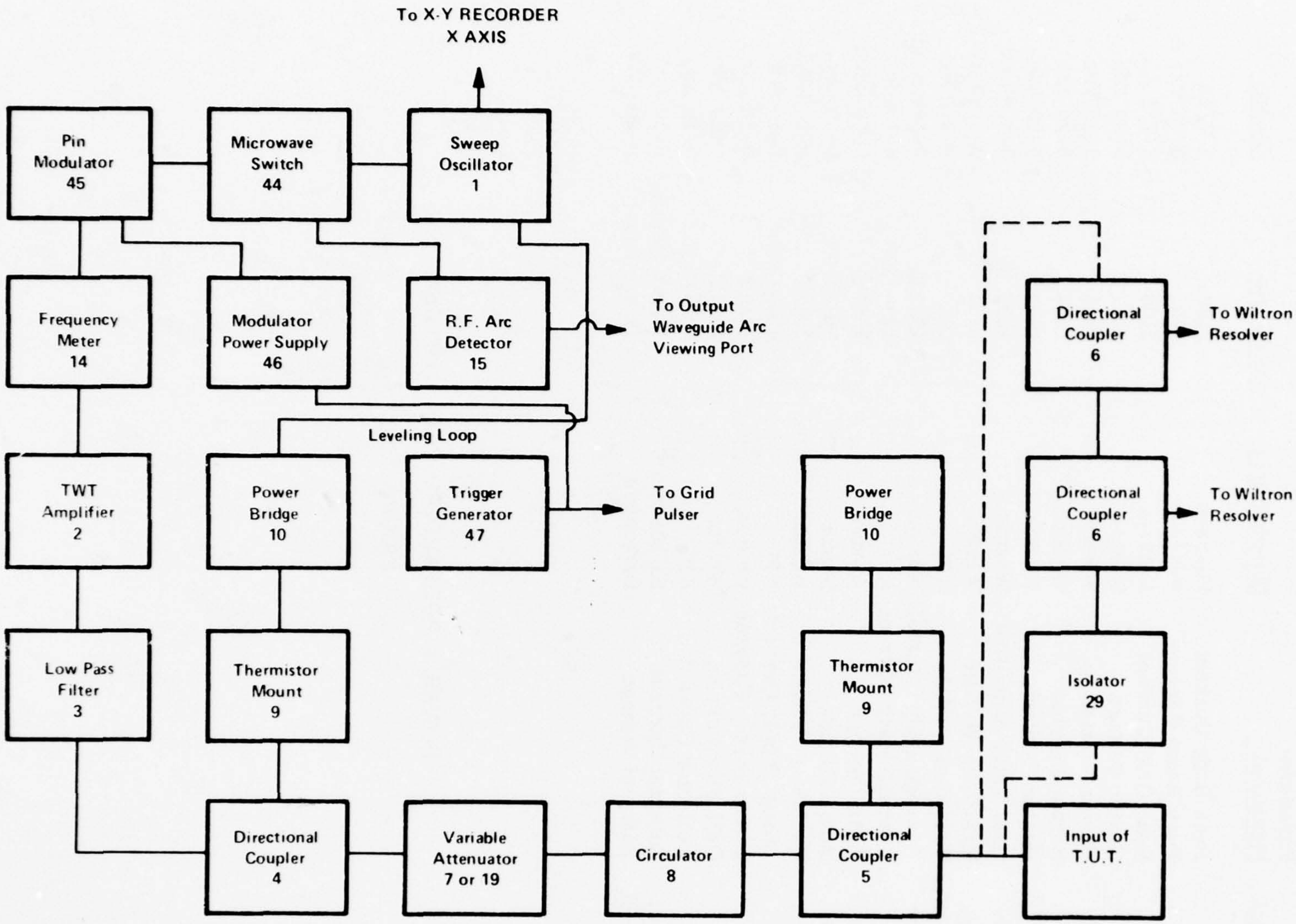


Figure 2.2A. Standard Input Test Setup

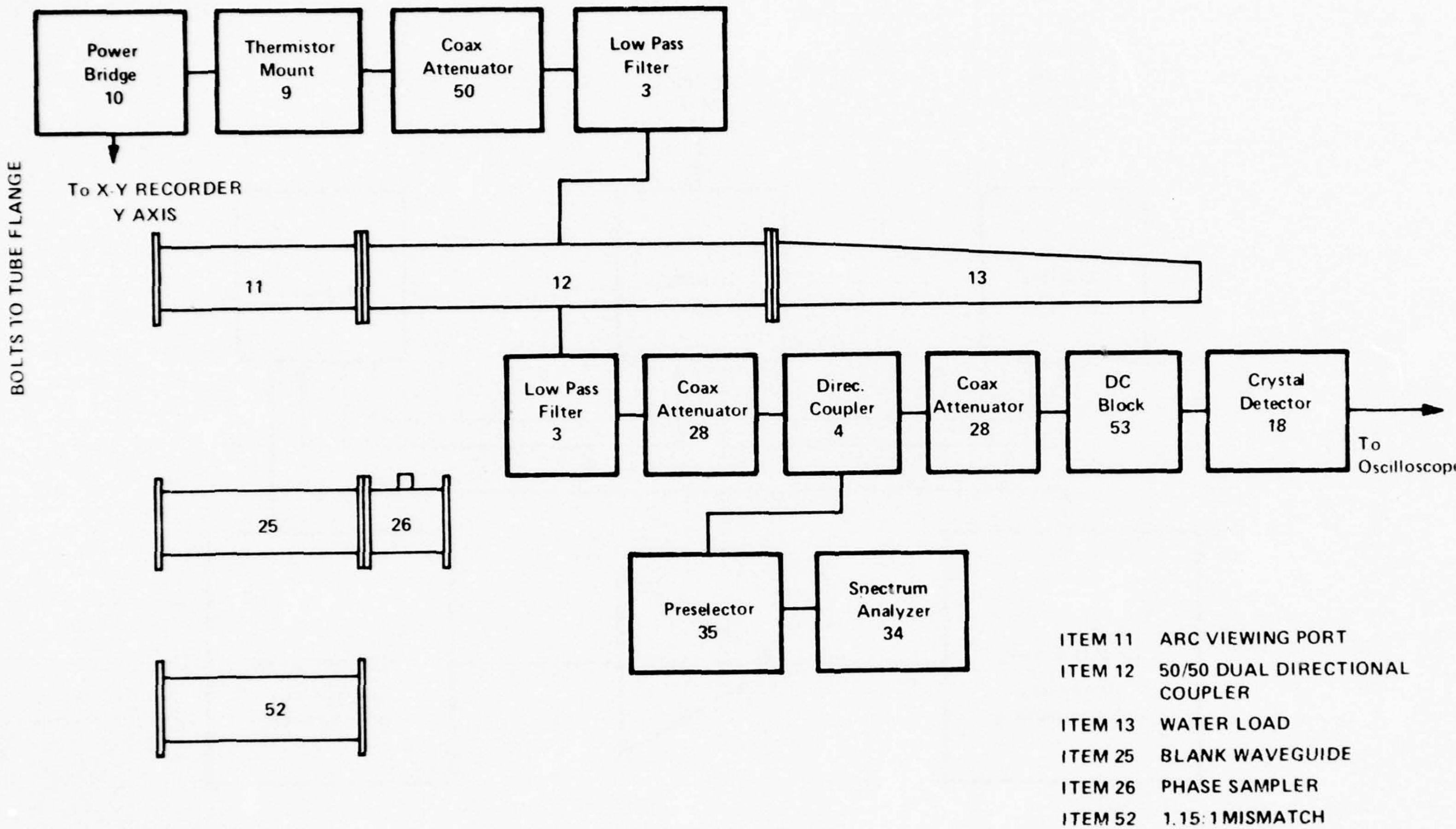


Figure 2.2B. Standard Output Test Setup

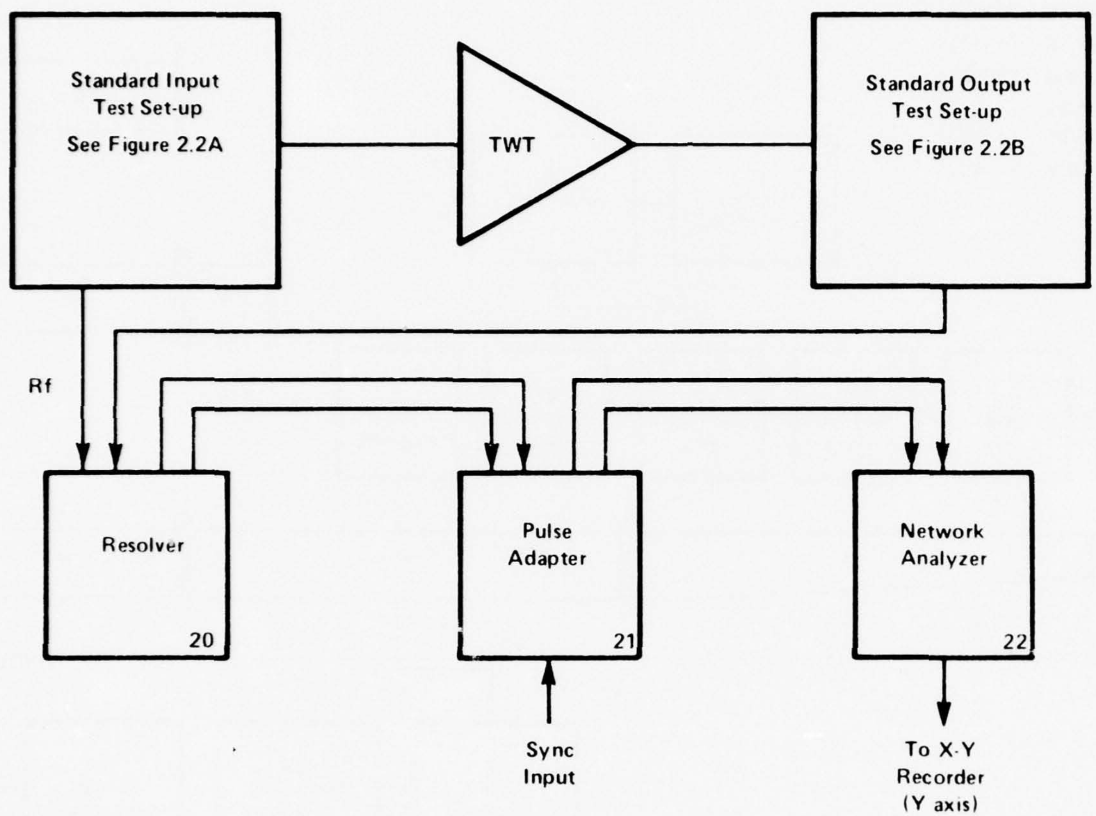


Figure 2.2C. Phase Linearity Test Setup

APPENDIX B

ACCEPTANCE TEST DATA
VTS-5753B1
TRAVELING WAVE TUBE

1. Amplitude as a function of rf drive
2. Phase as a function of rf drive
3. Phase pushing with ±1% change in beam voltage
4. Phase pushing with ±3% change in beam current
5. Phase pushing with ±1 kV change in collector depression
6. Amplitude and phase with a 1.25:1 VSWR
7. Amplitude and phase with a 1.25:1 VSWR shifted by $\lambda/2$ phase
8. Amplitude and phase at 8% duty factor
9. Amplitude and phase at 300 microsecond pulse length
10. Intrapulse phase modulation

ACCEPTANCE TEST DATA

VTS 5753B1

TRAVELING WAVE TUBE

SERIAL NO. 106

DATE 12/8/76

Prepared For:

RADC

Tested By:

VARIAN

DATE 12/9/76

VARIAN ASSOCIATES

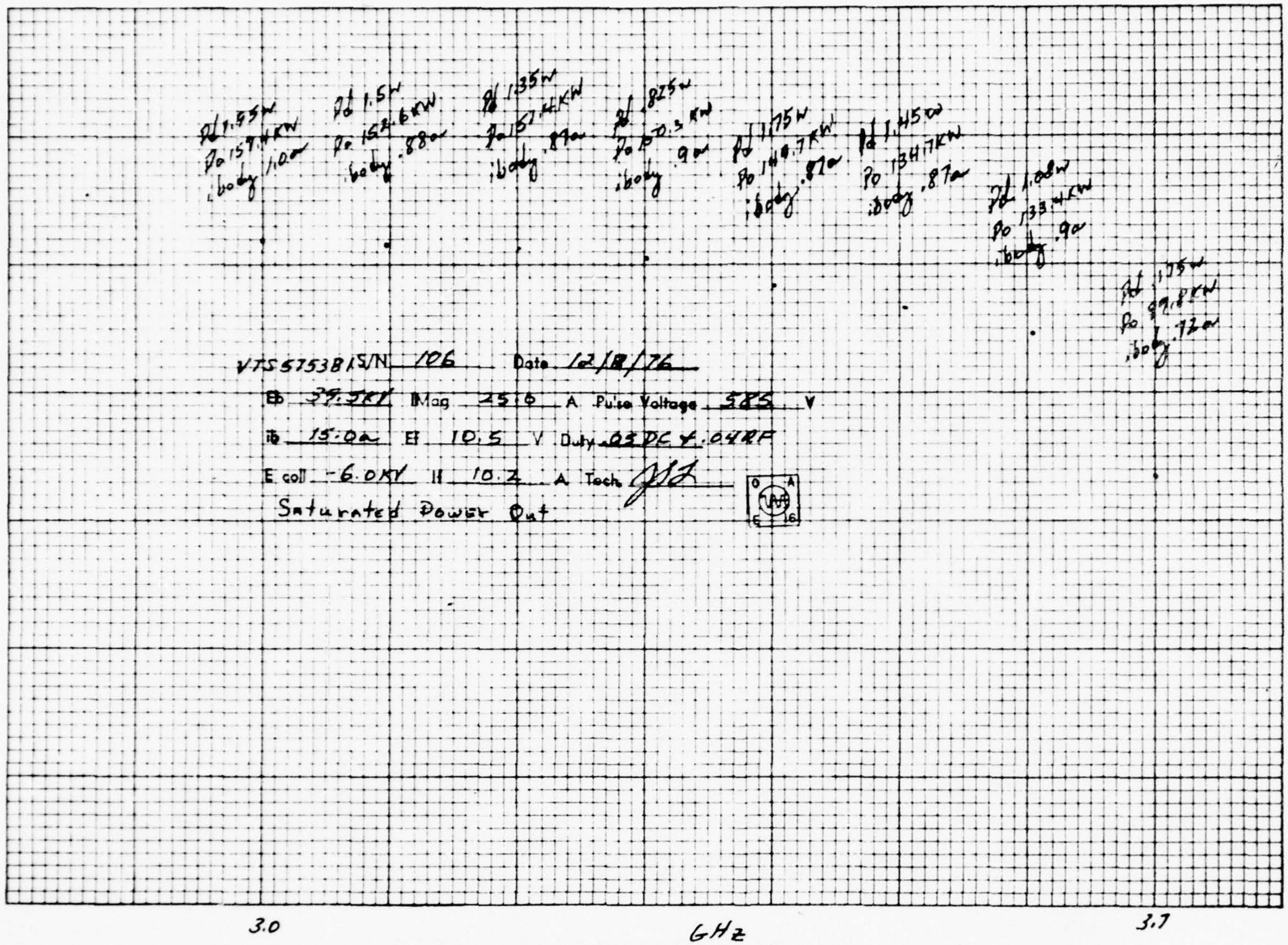
Palo Alto Microwave Tube Division

611 Hansen Way

Palo Alto, California 94303

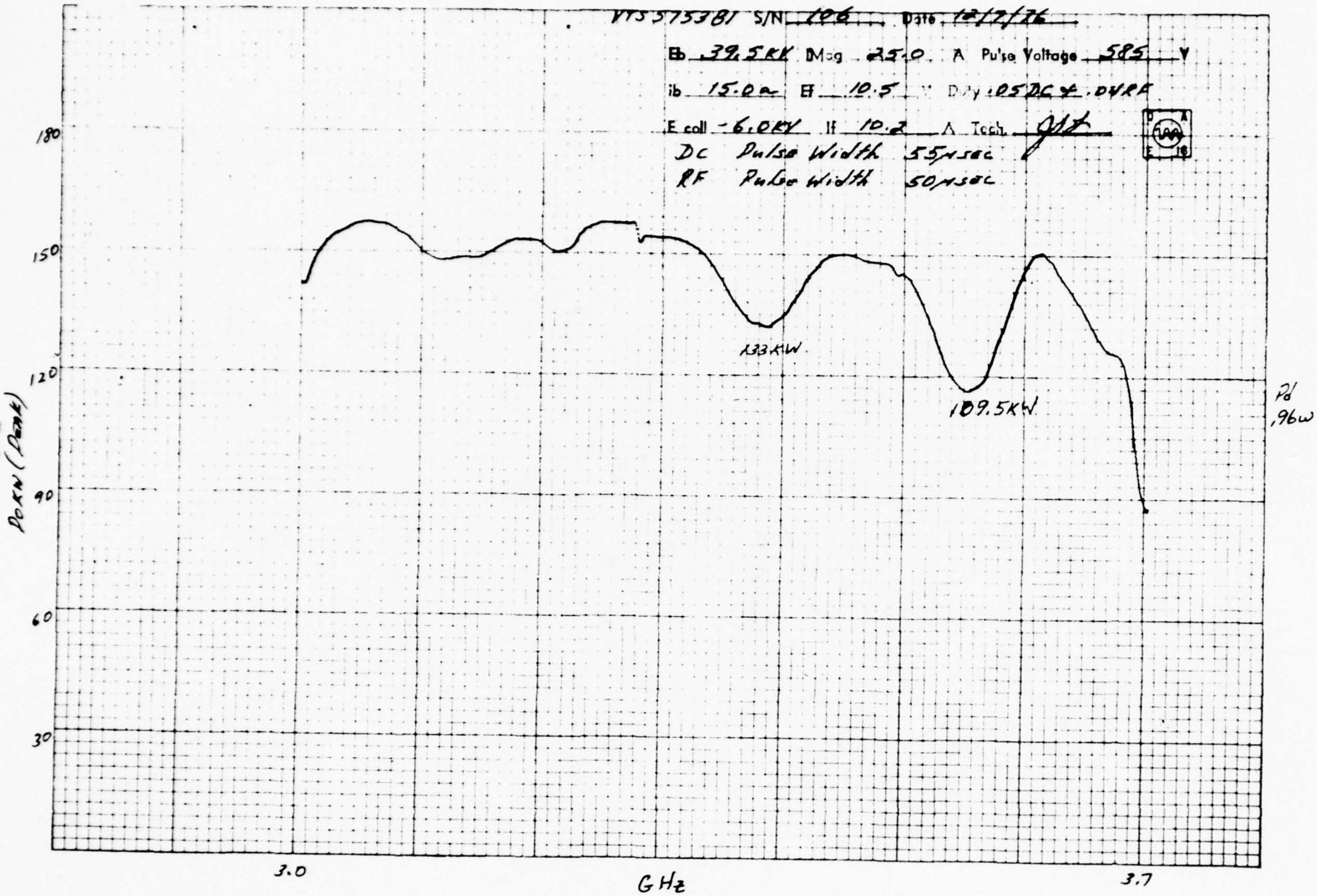
T E S T   P E R F O R M A N C E   S H E E T   VTS-5753B1   S/N 106

ATP Paragraph	Test Title	Min. Spec.	Not Freq. Rel.	Measured Value	Maximum Specification	Units
2.1.0	Liquid Coolant Resistivity	0.5	1.0			MΩ
2.1.1	Liquid Coolant Flow Rate	16	16.3		21	GPM
2.1.1	Air Coolant Flow Rate	30	>30			CFM
2.1.2	Bias Voltage	-500	-600		-700	V
2.1.3	Beam Voltage		39.5		44.0	kV
2.1.3	Collector Voltage w.r.t. Body	-1.5	-6.0		-6.0	kV
2.1.4	Heater Voltage	9.5	10.5		11.0	V
2.1.4	Heater Current	9.0	10.2		11.0	A
2.1.5	Peak Grid Current (ik=NPV)		22		50	ma
2.1.5	Grid Pulse Voltage (ik = NPV)	400	585		900	v
2.1.5	Peak Cathode Current		15.0		17	a
2.1.5	Peak Body Current (Pd =0)		0.175		0.05 ik	a
2.1.5	Peak Collector Current	.95ik	14.825			a
2.1.5	Solenoid Current	22	25.0		26	A
2.1.5	Solenoid Voltage	125	141		200	V
2.1	RF Drive Level		0.96		12.5	w
2.2.1	Ion Pump Voltage		3.5		3.5	kV
2.2.1	Ion Pump Current		0.4		20	μA
3.1	Phase Linearity Test (Matched Output)			See Graph		
4.1	Amplitude Linearity (Matched Output)			See Graphs		
4.1.4.7	Peak Body Current (Pd = NP)		1.0		1.5	a

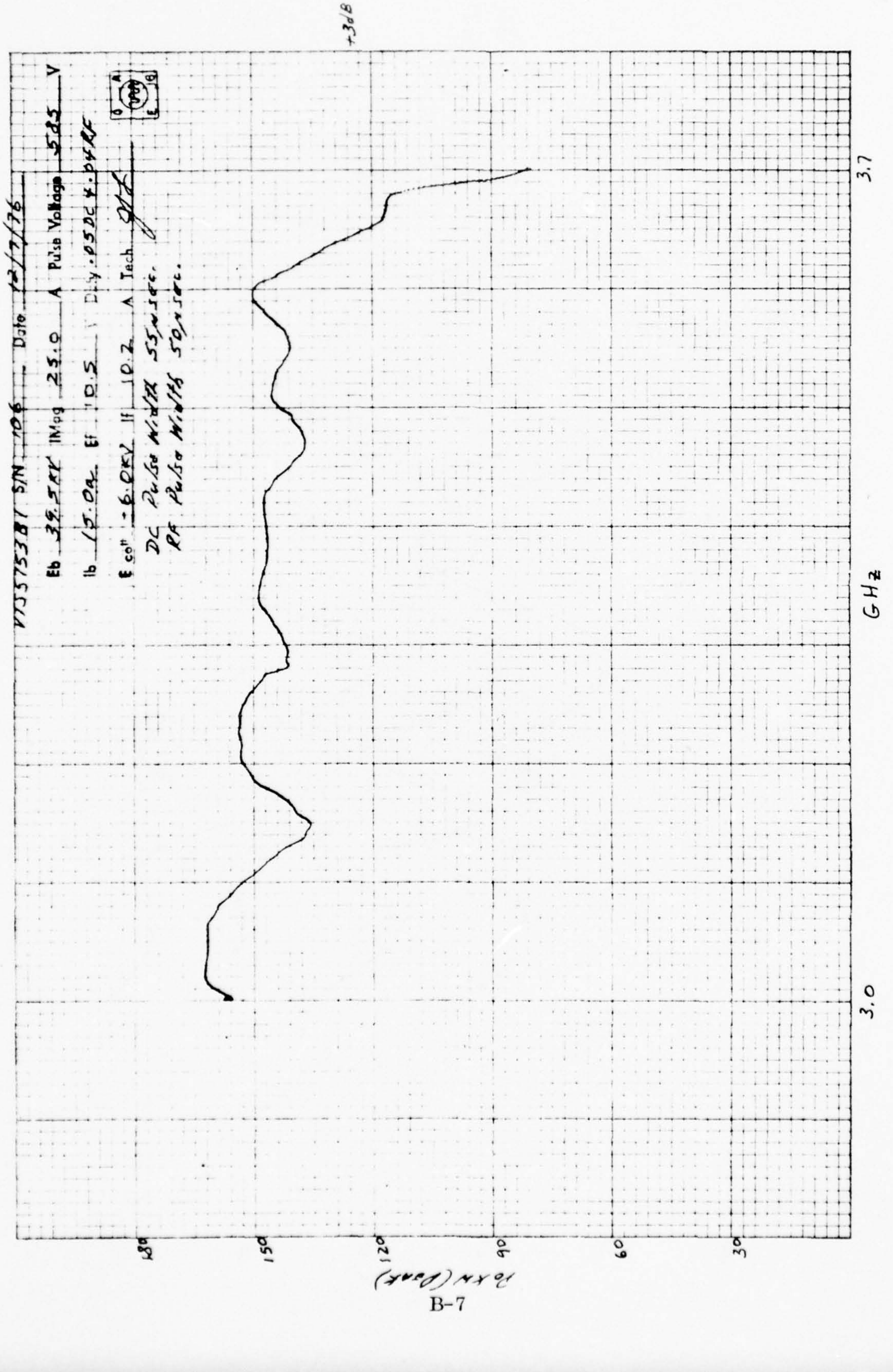


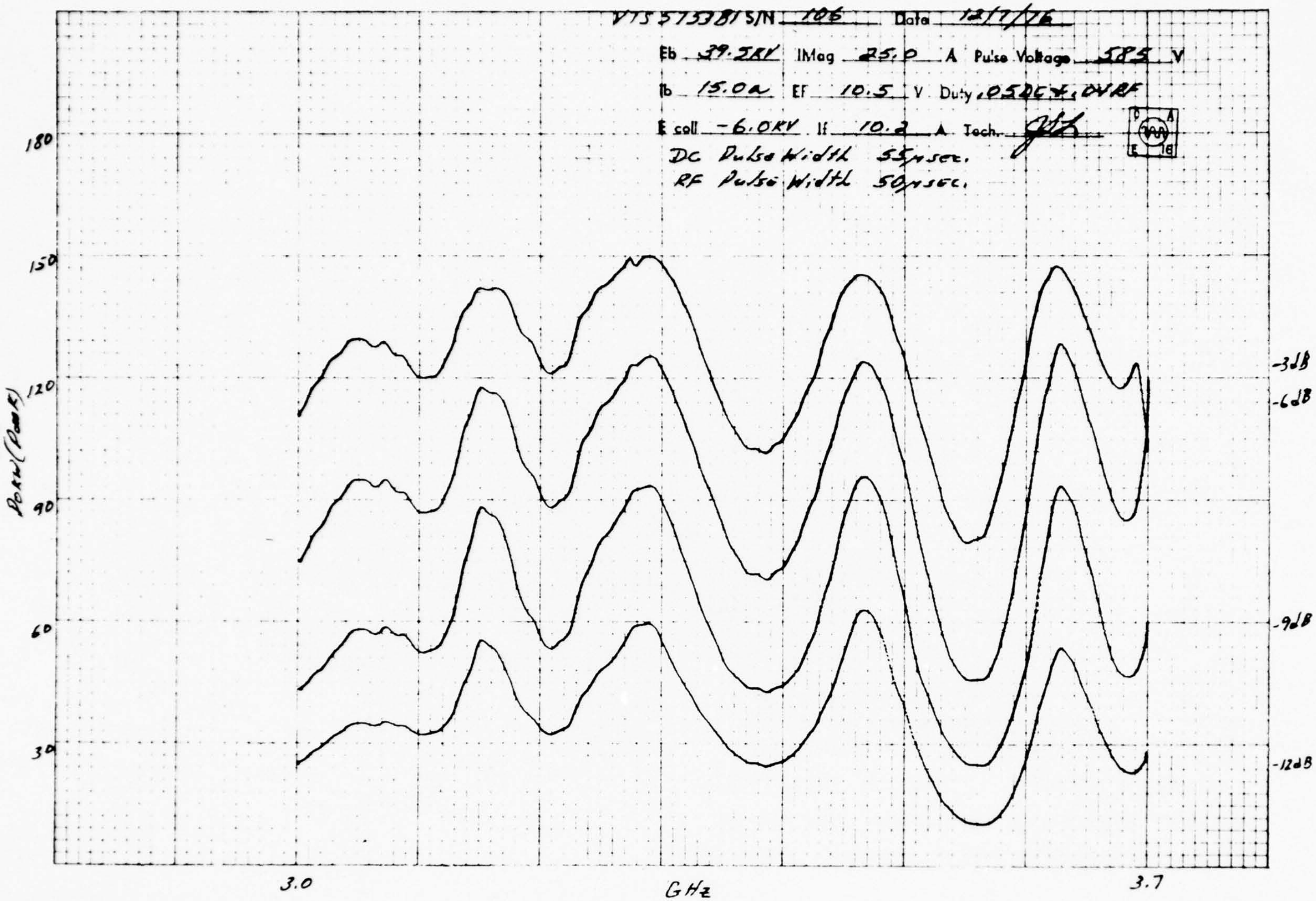
VTS5753B1 S/N 106 Date 12/18/76
Eb 39.5KV IMag 25.6 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 V Duty .03DC + .04RF
E coll -6.0KV If 10.2 A Tech
Saturated Power Out
3.0
GHz
3.7

1. Amplitude as a function of rf drive



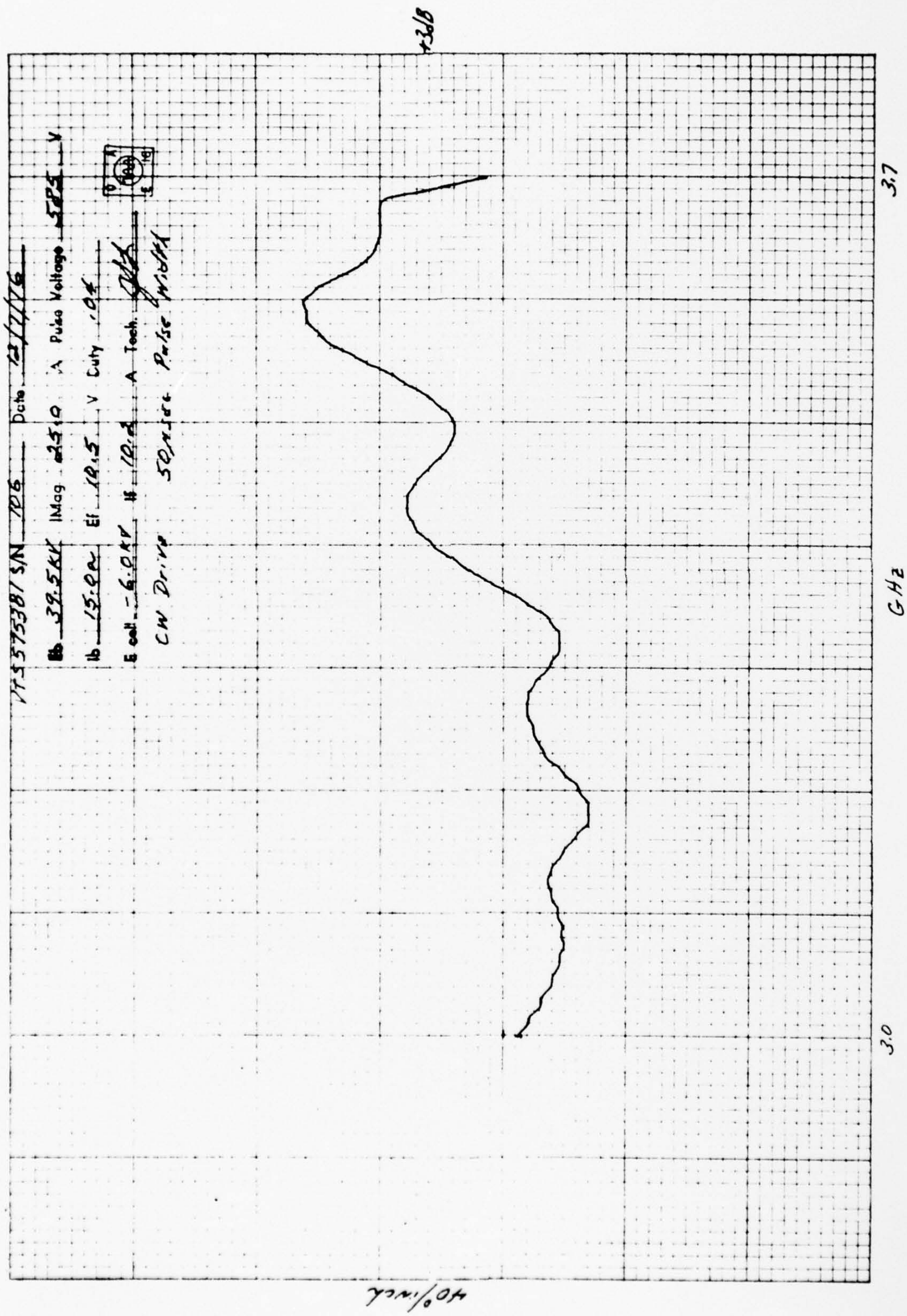
VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 V Duty .05DC + .04RF
E coll -6.0KV If 10.2 A Tech
DC Pulse Width 55μsec
RF Pulse Width 50μsec
133KW
109.5KW
Pd .96w
180
150
120
90
60
30
Po KW (Peak)
3.0
3.7
GHz


S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .05DC + .04RF
E col -6.0KV If 10.2 A Tech
DC Pulse Width 55μsec.
RF Pulse Width 50μsec.
+3dB
3.0
3.7
GHz
180
150
120
90
60
30
Po KW (Peak)

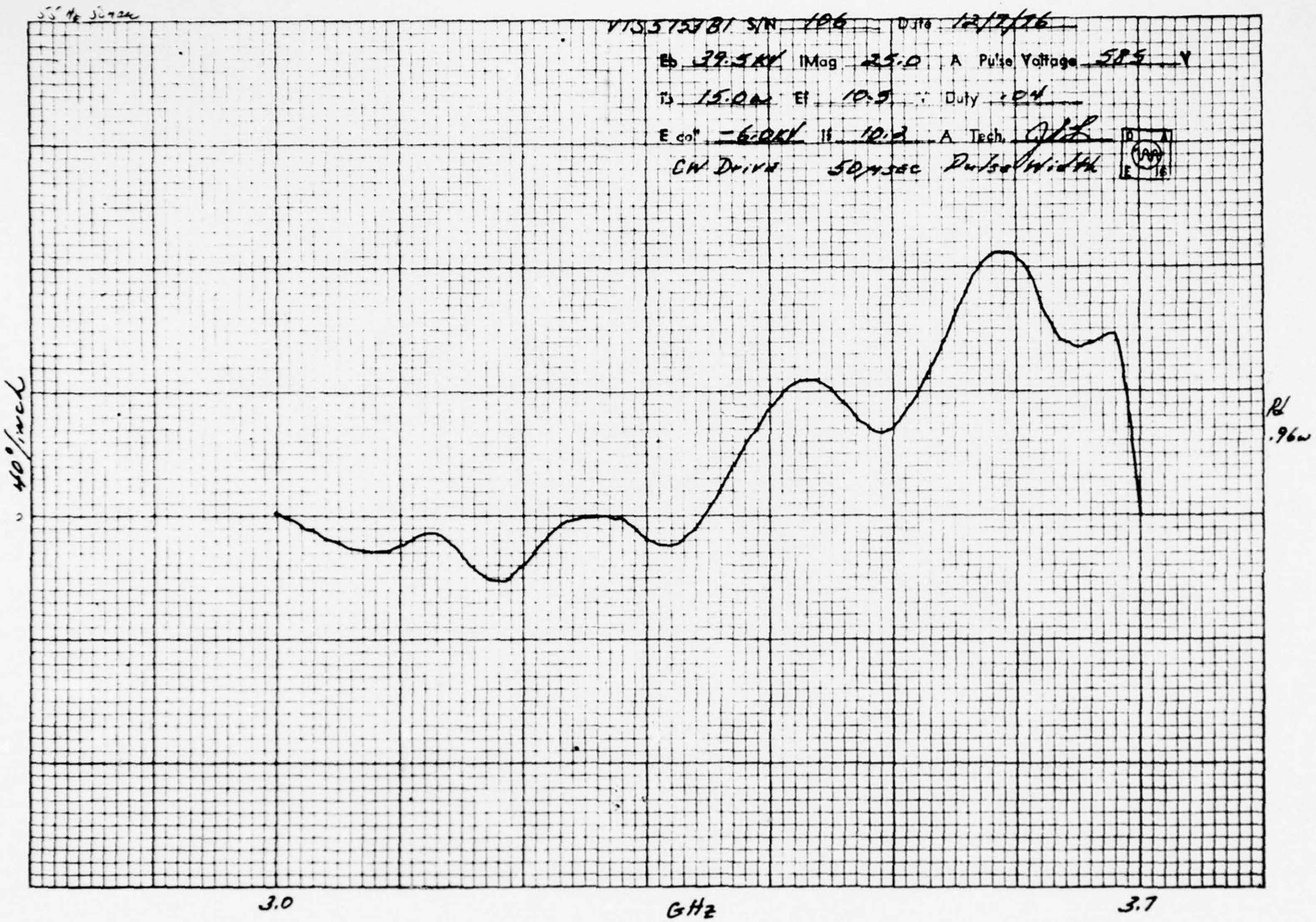


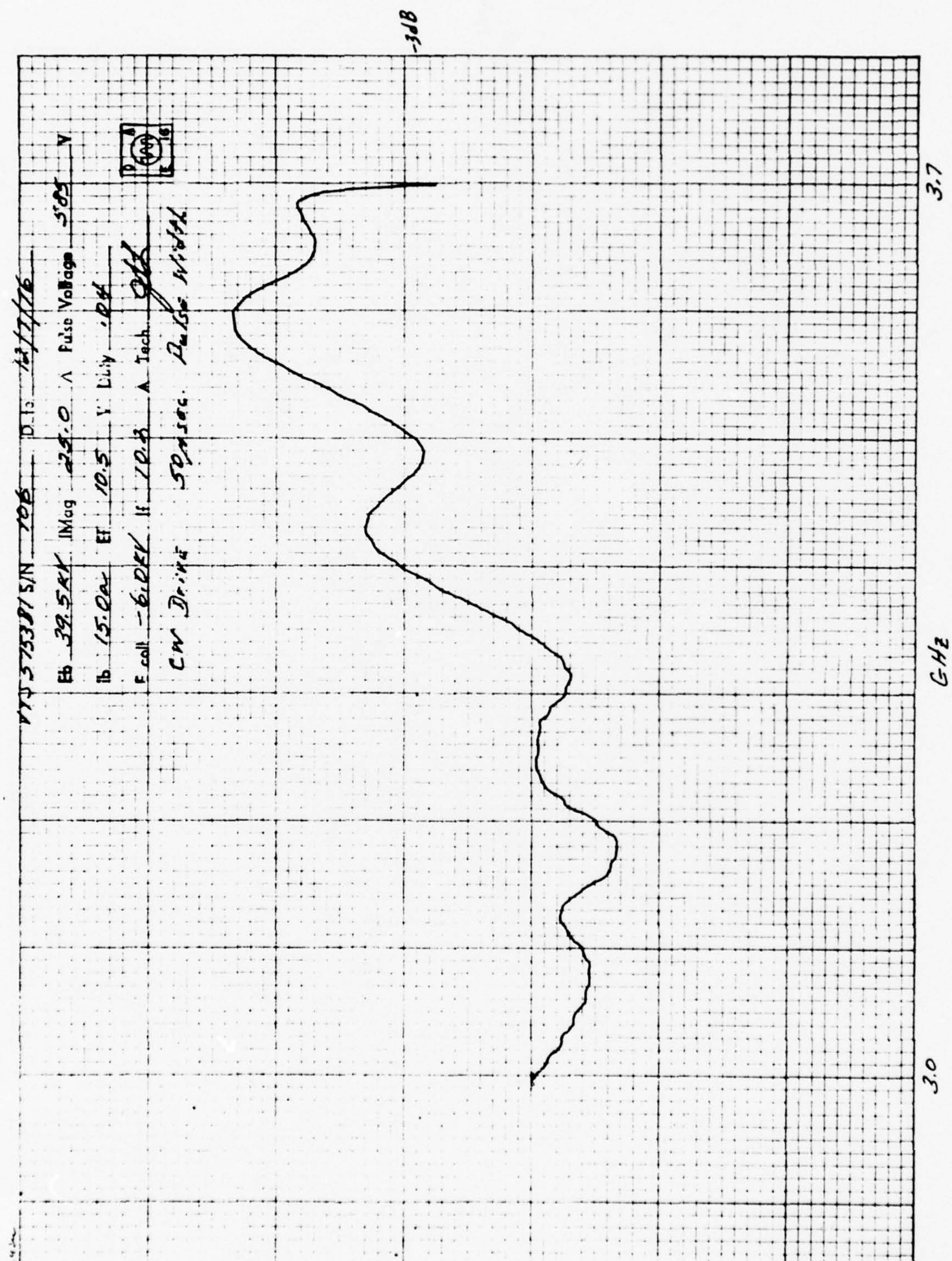
VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a EF 10.5 V Duty .05DC+.0VRF
E coll -6.0KV If 10.2 A Tech.
DC Pulse Width 55μsec.
RF Pulse Width 50μsec.
180
150
120
90
60
30
Porw (Peak)
-3dB
-6dB
-9dB
-12dB
3.0
GHz
3.7

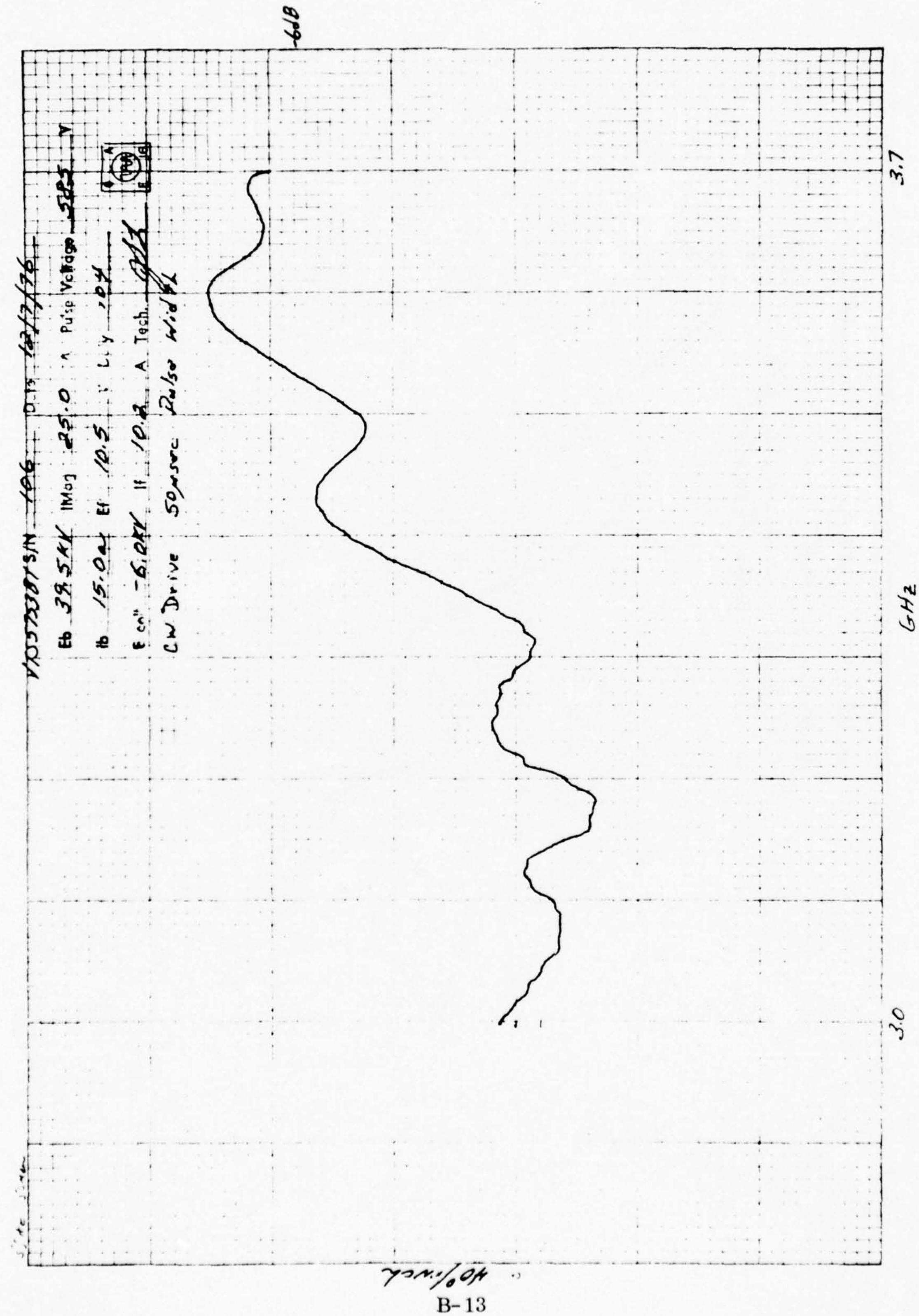
2. Phase as a function of rf drive

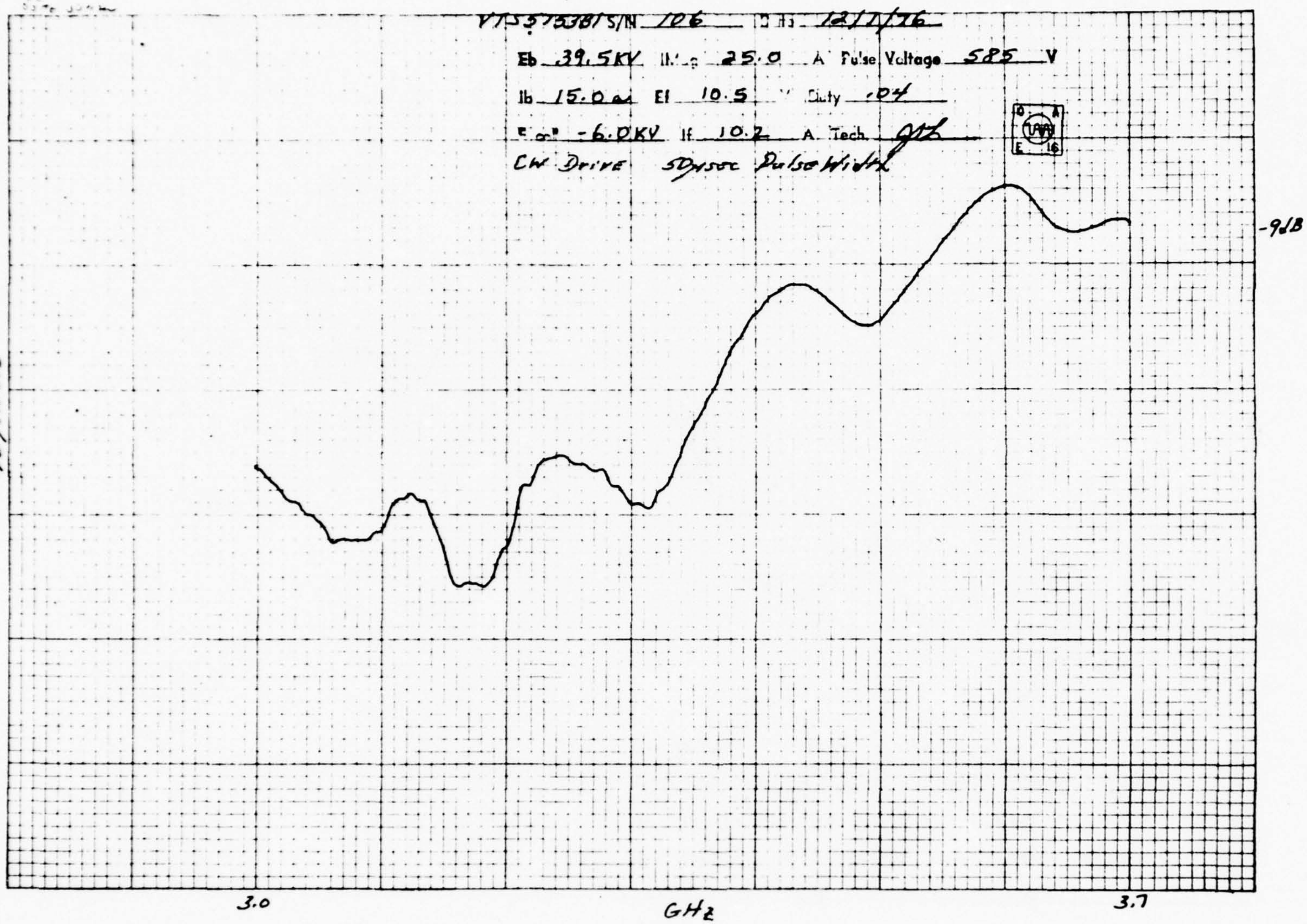


Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
CW Drive 50μsec Pulse Width
+3dB
3.0
3.7
GHz
40°/inch

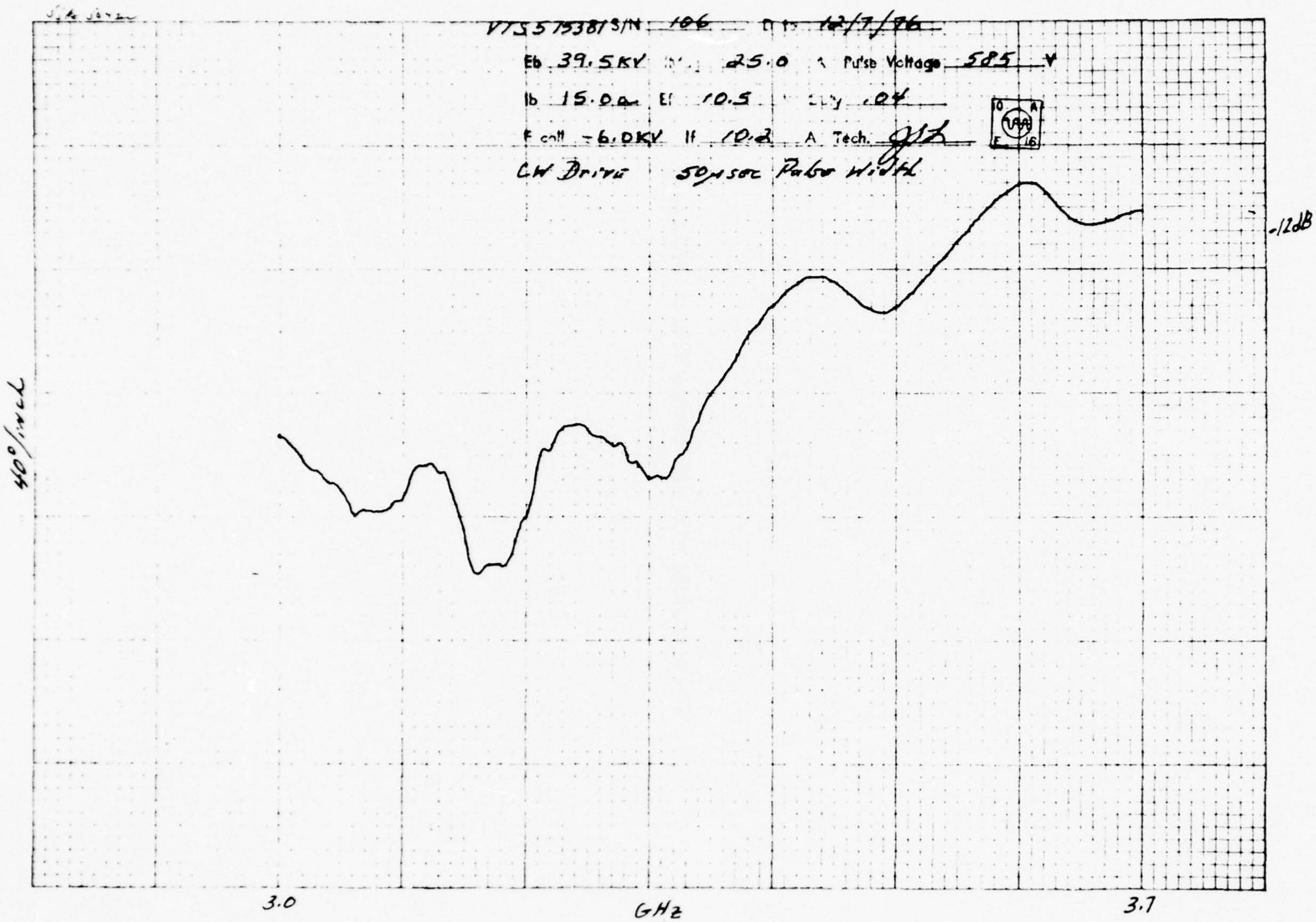

55' Hz Sweep
VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .04
E col -6.0KV If 10.2 A Tech.
CW Drive 50μsec Pulse Width
40°/inch
Pd .96w
3.0
GHz
3.7


VTS 5753B1 S/N 106 D.T. 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .04
E coll -6.0KV If 10.3 A Tech
CW Drive 50μsec. Pulse Width
-3dB
3.0
GHz
3.7
40°/inch


S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V
E coll -6.0KV If 10.2 A Tech.
CW Drive 50μsec Pulse Width
-6dB
3.7
GHz
3.0
40/inch

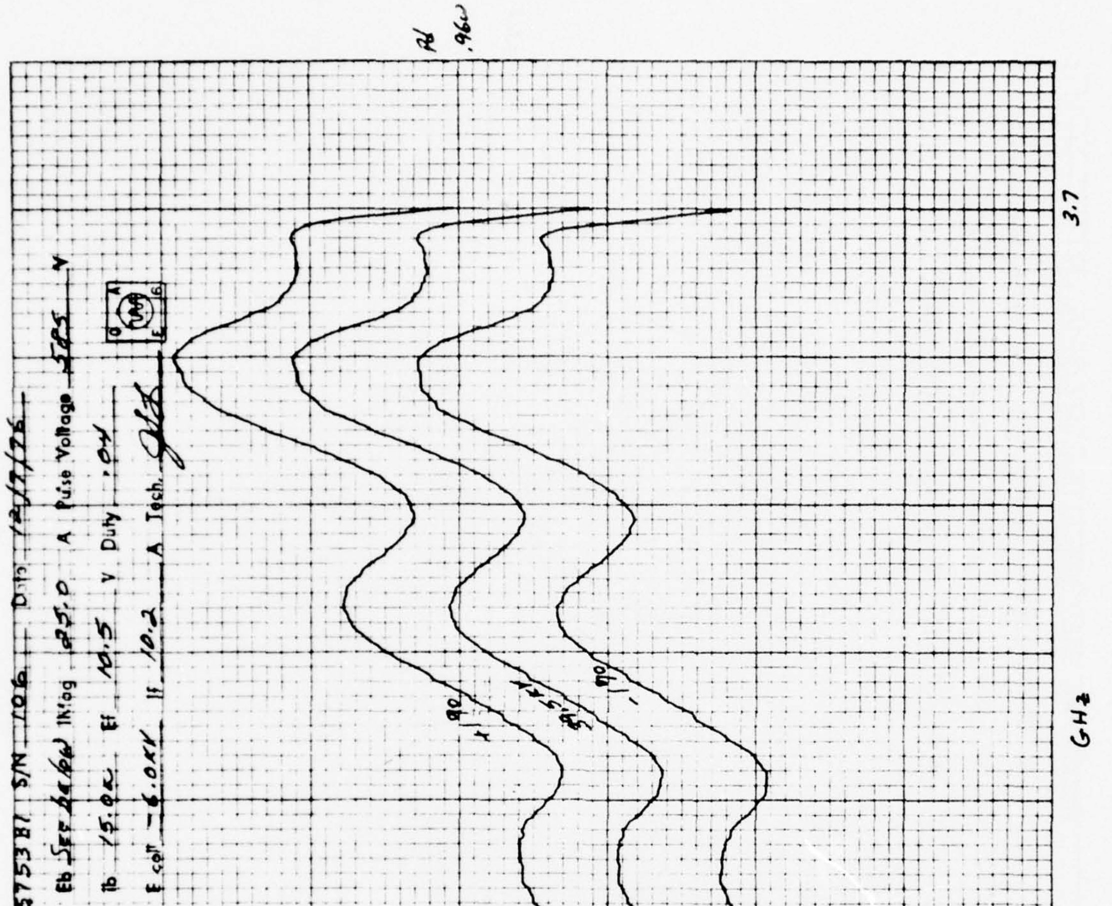


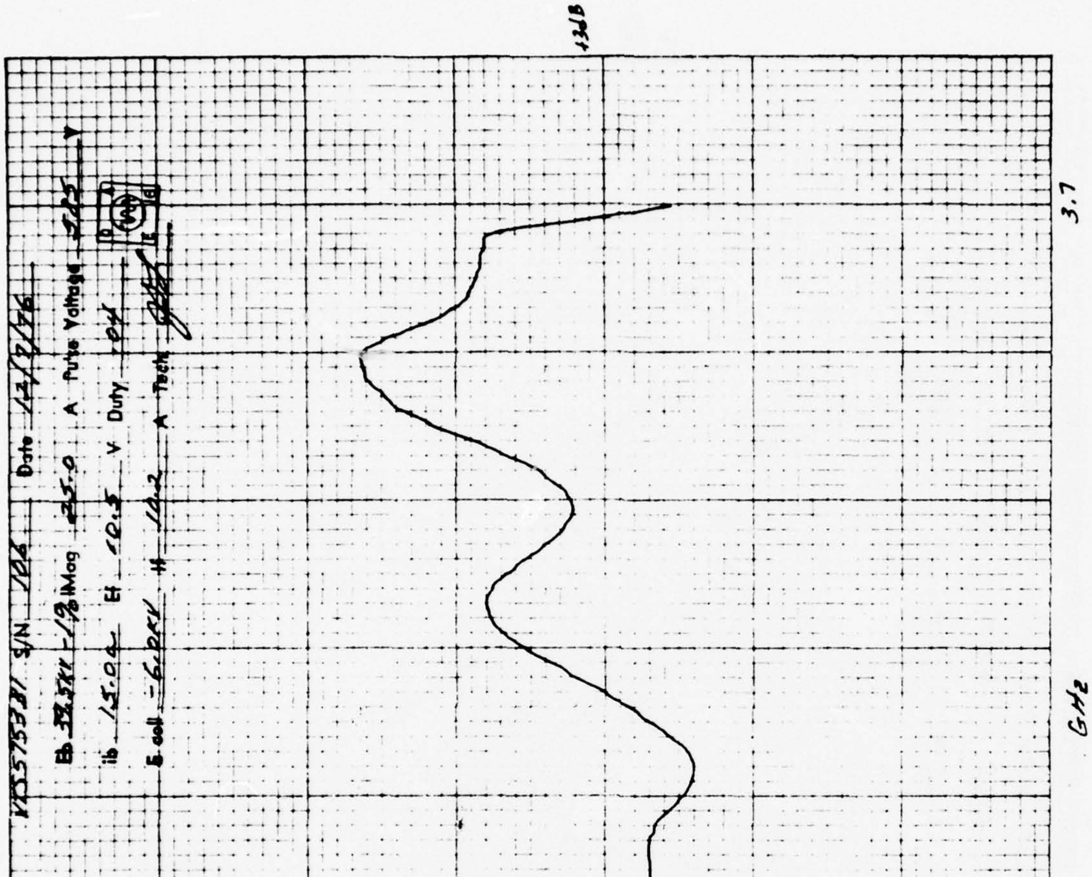
VTS5753B1 S/N 106 12/7/76
Eb 39.5KV A Pulse Voltage 585 V
Ib 15.0 Duty .04
El 10.5
-6.0KV If 10.2 A Tech
CW Drive 50μsec Pulse Width
-9dB
40°/inch
3.0
GHz
3.7



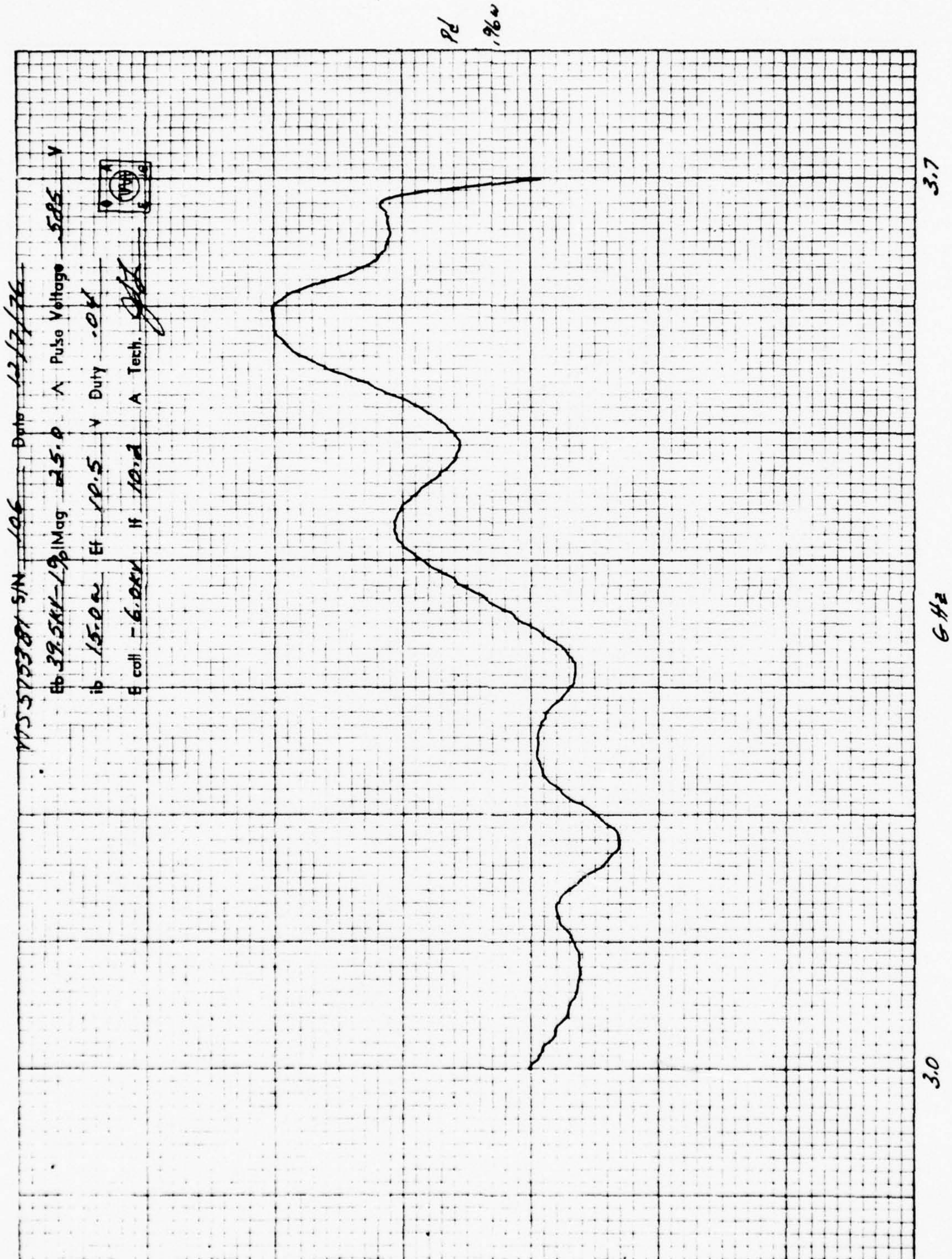
VTS5753B1 S/N 106
12/7/76
Eb 39.5KV
25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5
.04
F coll -6.0KV If 10.2 A Tech.
CW Drive 50μsec Pulse Width
-12dB
3.0
GHz
3.7
40°/inch

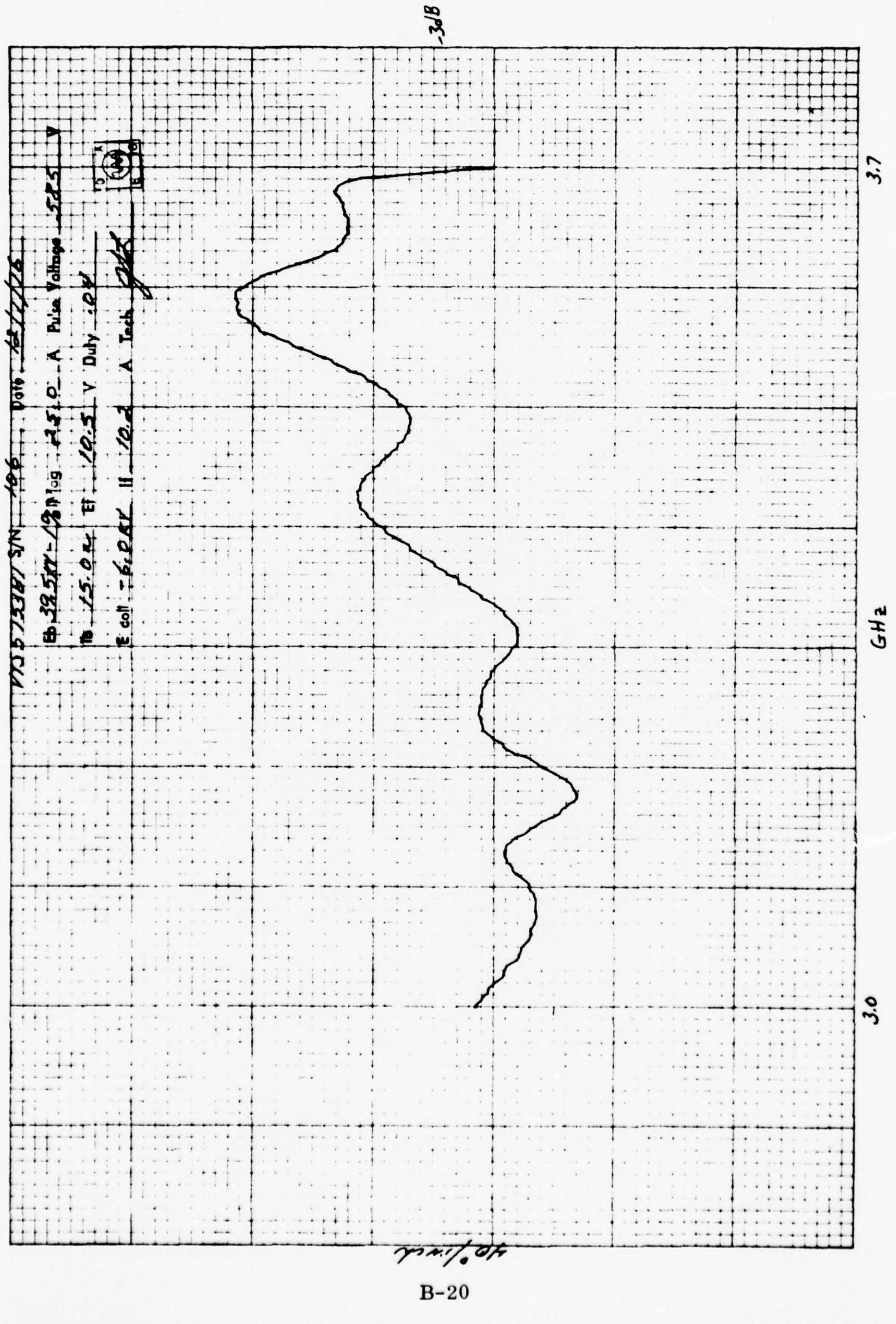
3. Phase pushing with $\pm 1\%$ change in beam voltage

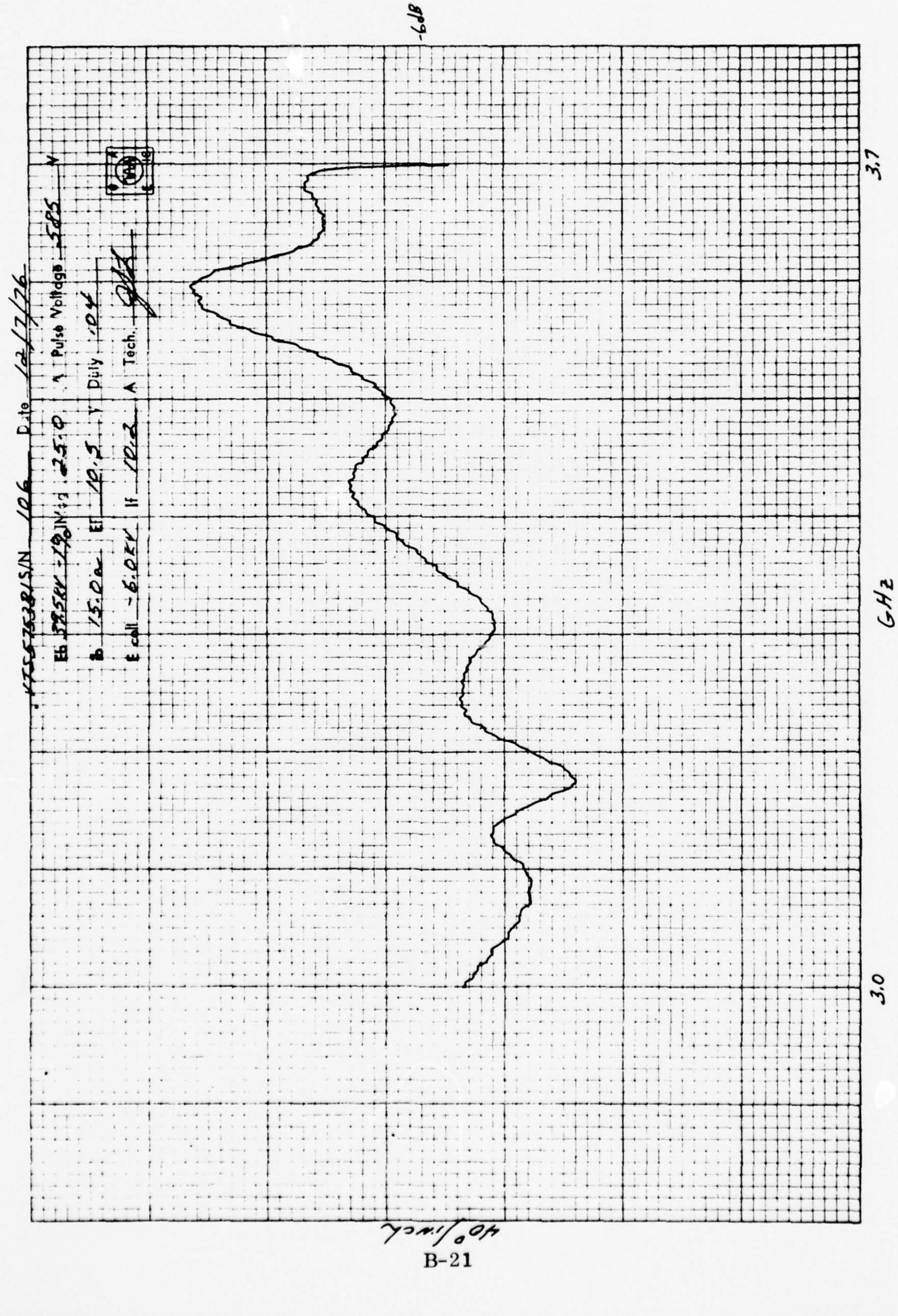

VTS-5753B1 S/N 106 Date 12/7/76
Eb See Below Ikag 25.0 A Pulse Voltage 5.25 V
Ib 15.0 Ef 10.5 V Duty .04
E coll -6.0 KV If 10.2 A Tech.
Pd .96w
+1%
-1%
3.0
3.7
GHz
40°/inch



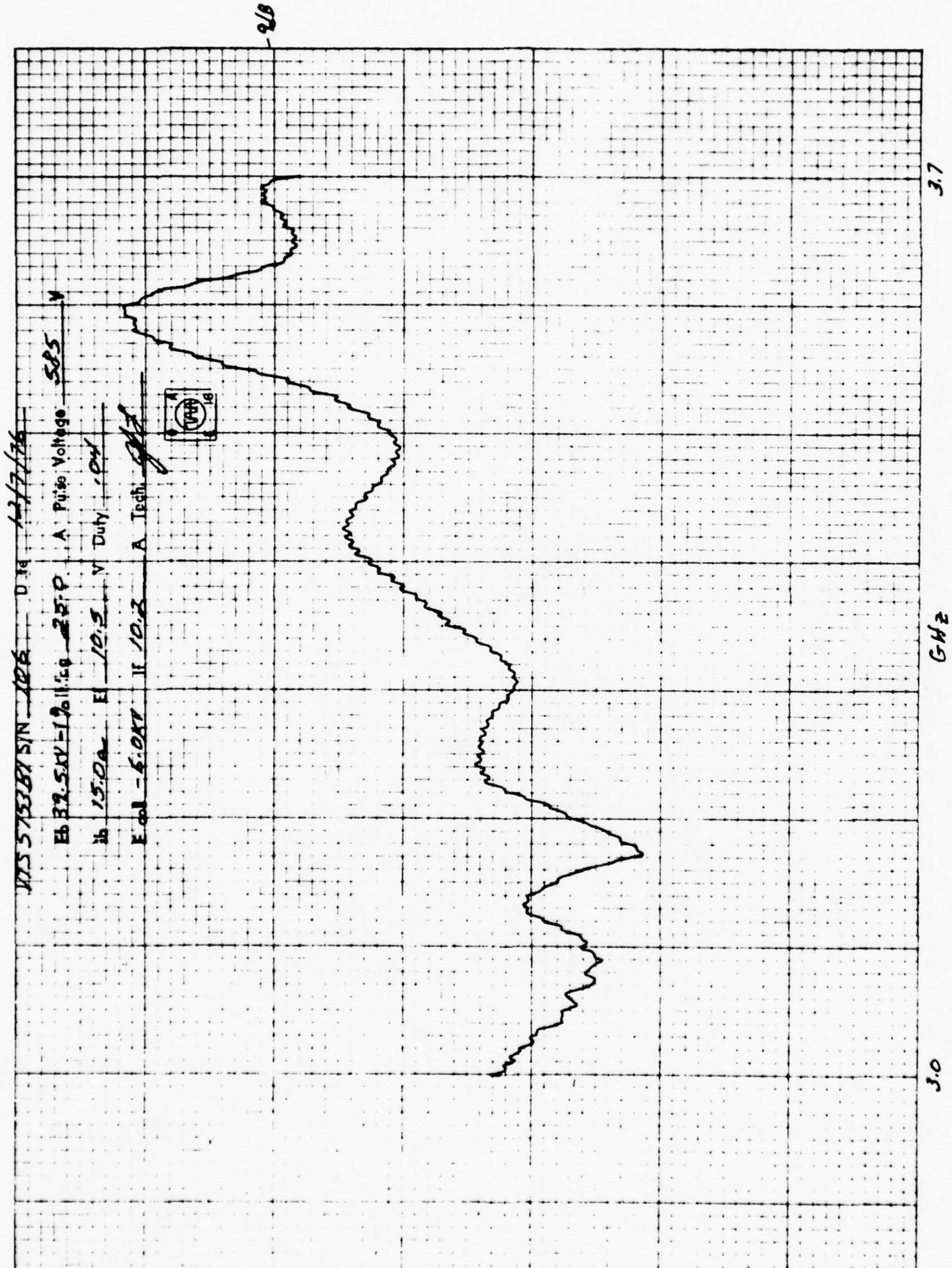
S/N
Date
Eb
Mag
25.0
A
Pulse Voltage
V
ib
15.0
Ef
10.5
V
Duty
.04
E coll
If
10.2
A
Tech
3.0
GHz
3.7

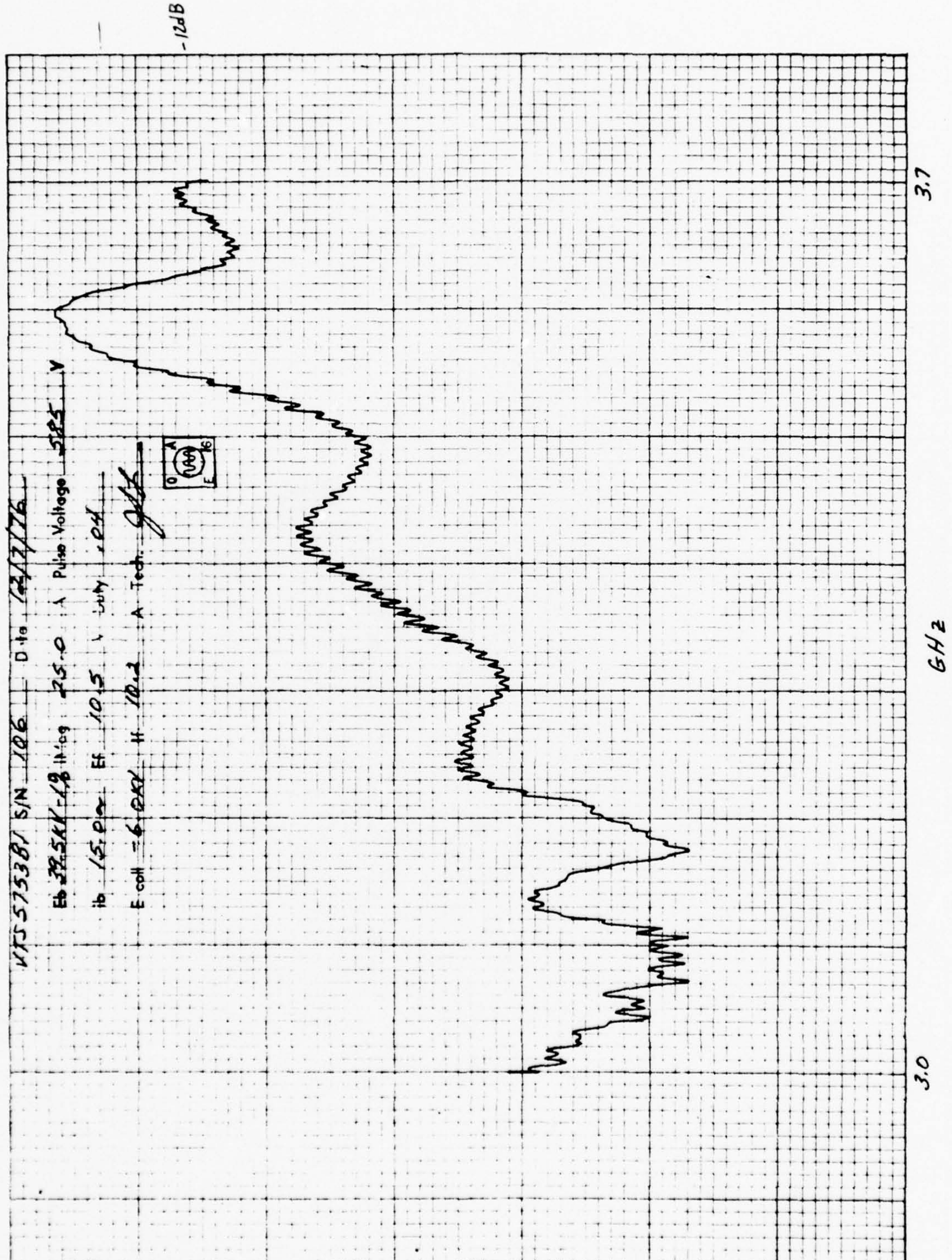

S/N
Date
Mag
A
Pulse Voltage
V
ib
Ef
V
Duty
E coll
If
A
Tech.
3.0
3.7
GHz

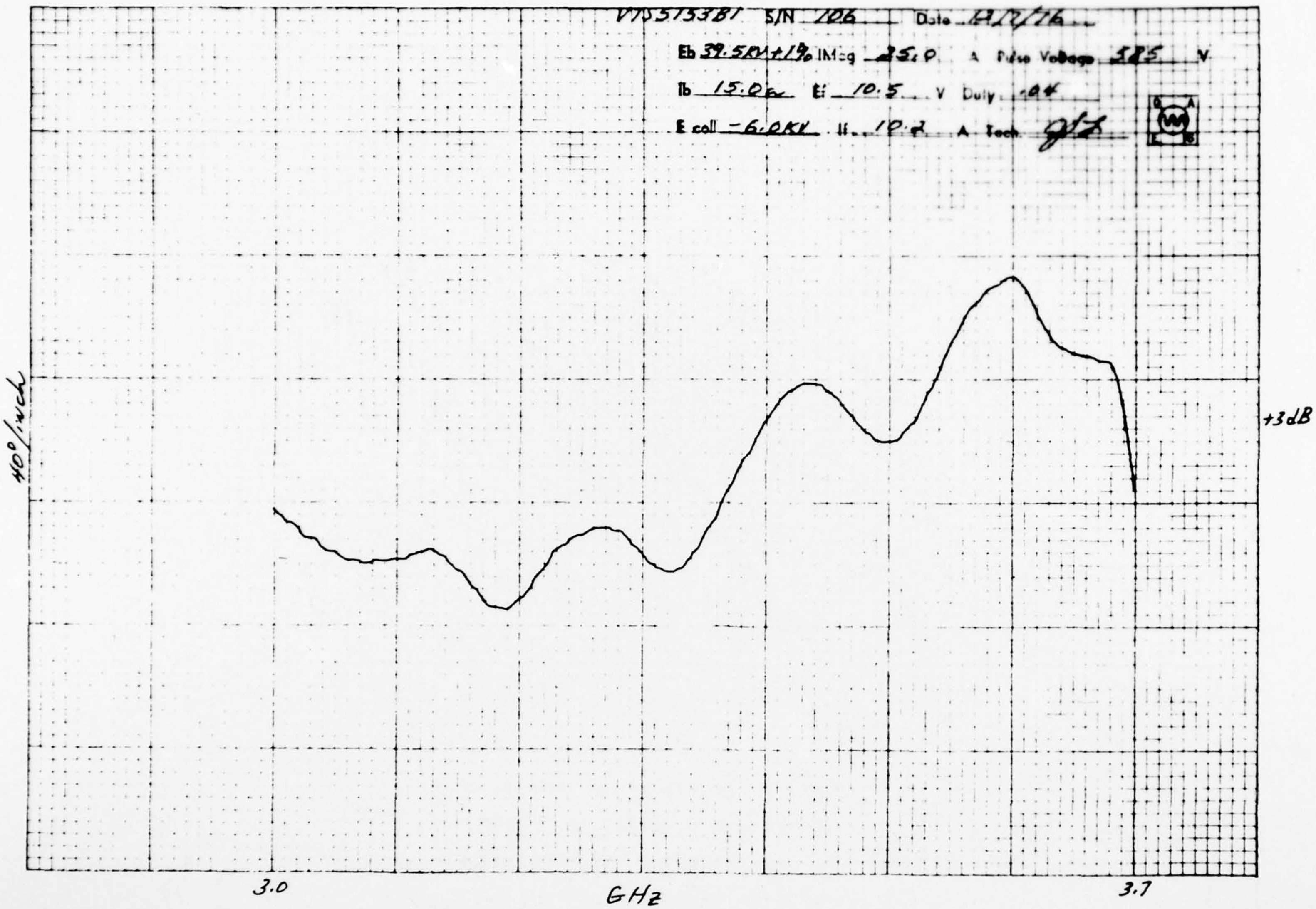

-3dB
3.7
GHz
3.0
40°/inch

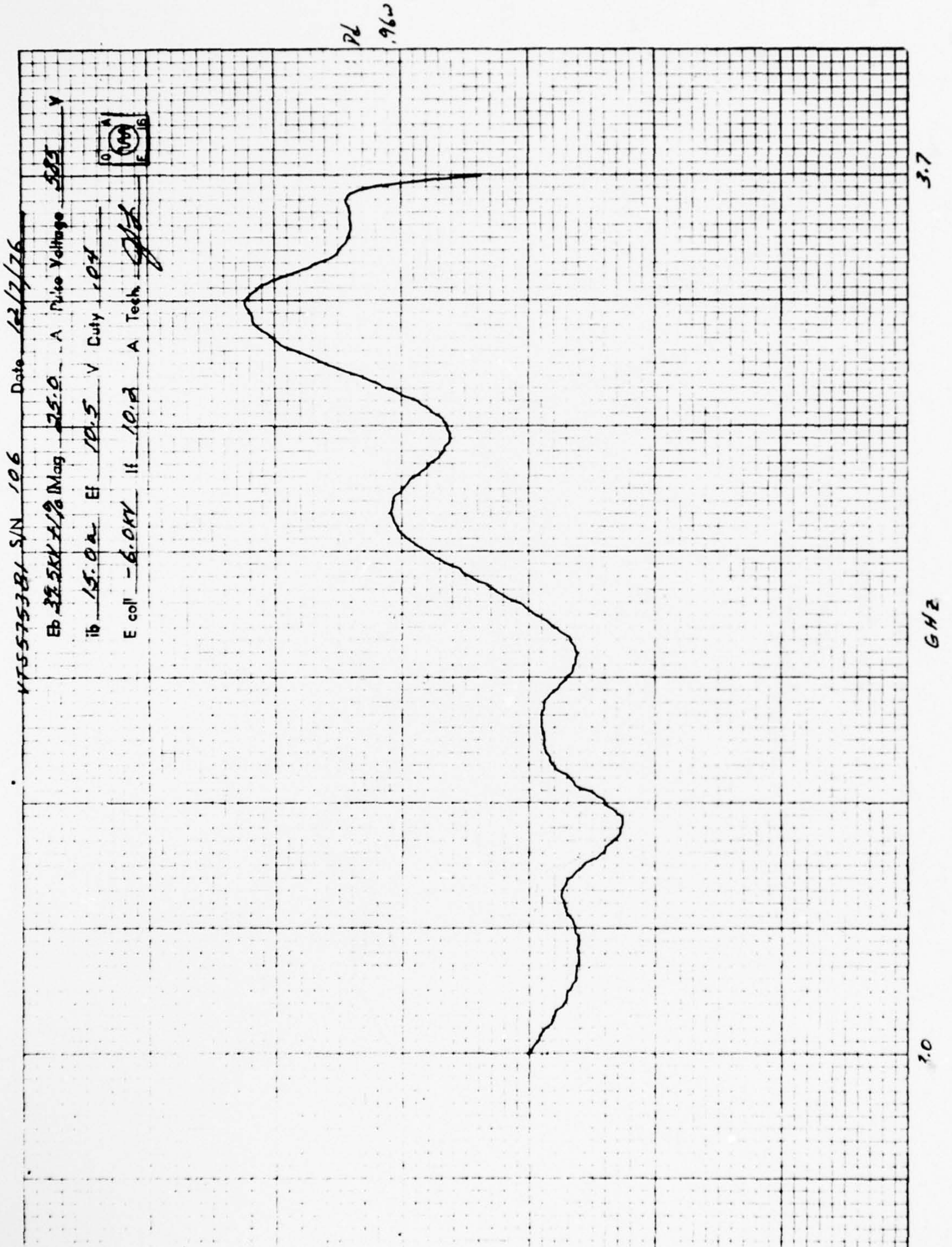


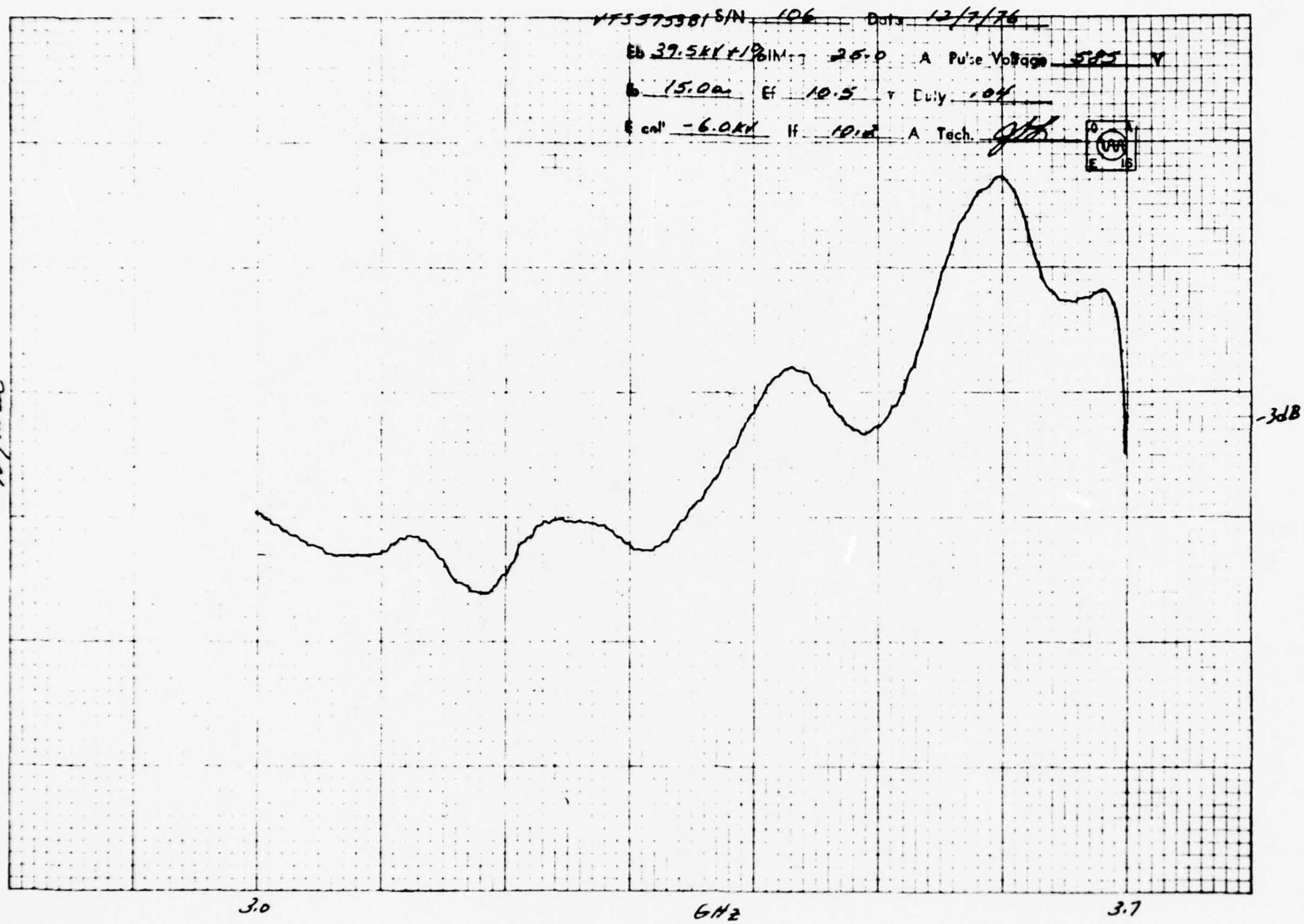
S/N 106
Date 12/7/76
Pulse Voltage 585 V
Duty .04
Tech.
-6dB
3.7
GHz
3.0
40°/inch

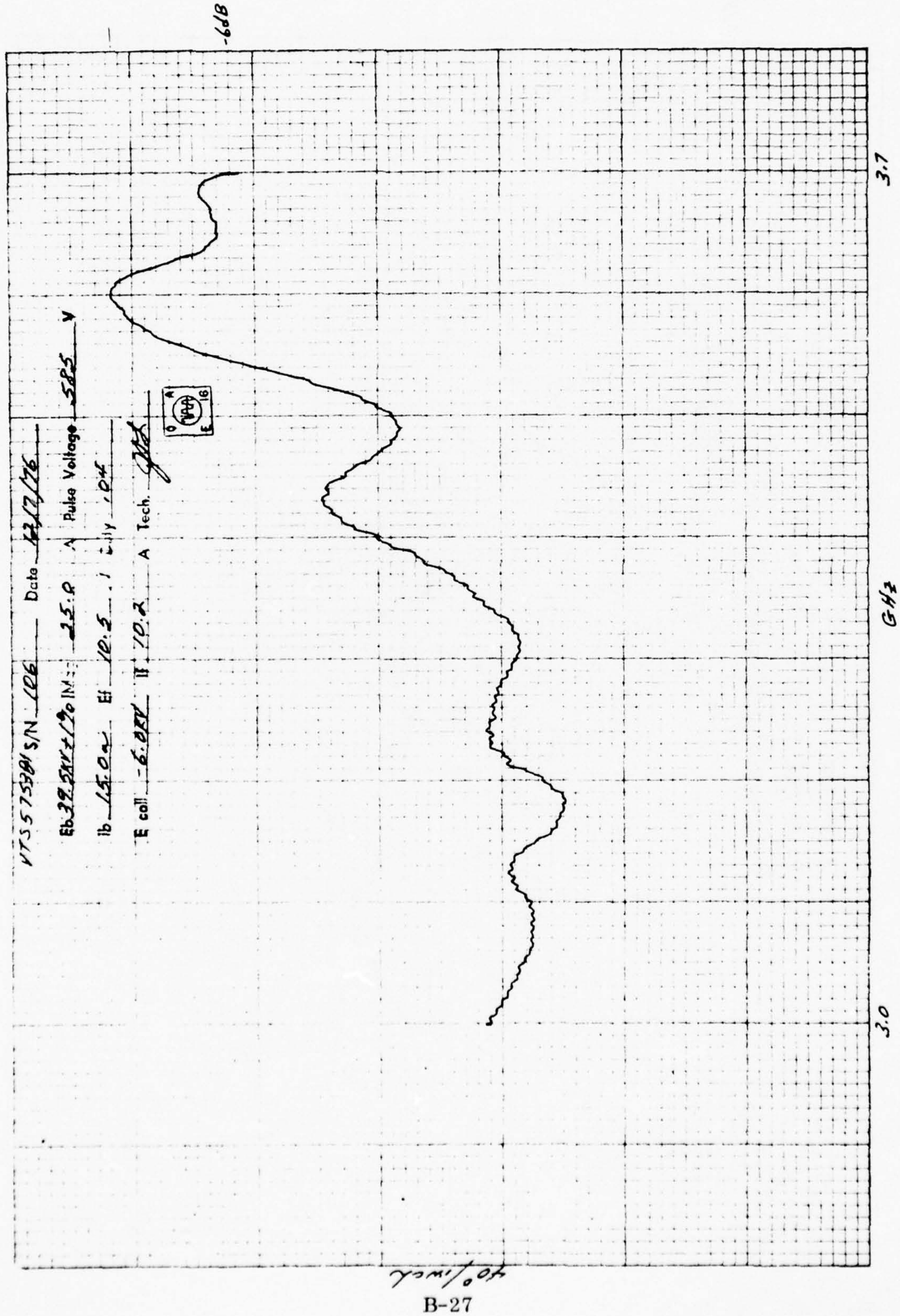

VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV-19 Ic 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .04
Ecol -6.0KV If 10.2 A Tech
2dB
3.0
3.7
GHz
40%/inch

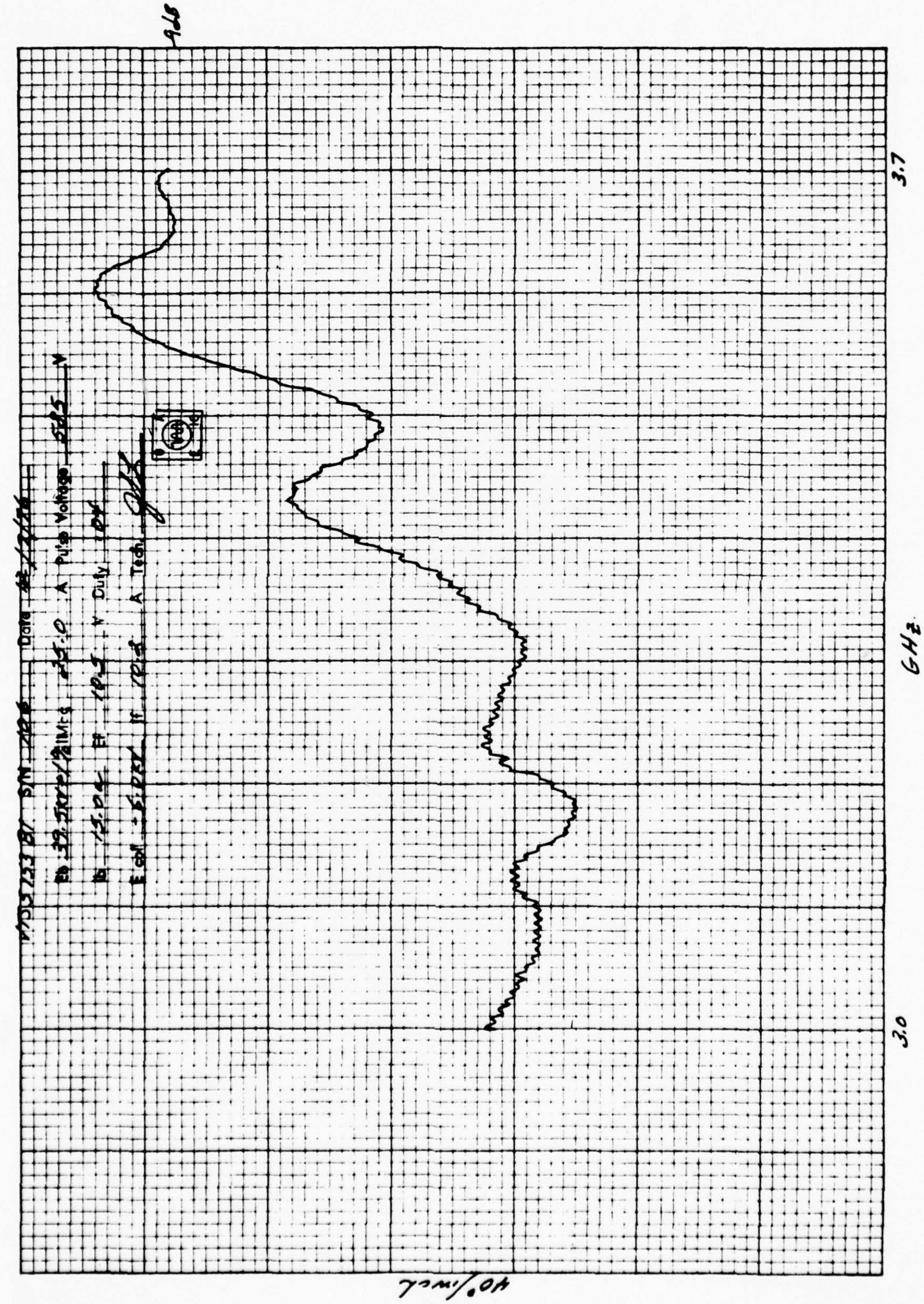

VTS5753B1 S/N 106 Date 12/7/76
Eb Pulse Voltage 5185 V
ib Ef 10.5 Duty .04
E coll If 10.2 A Tech.
-12dB
3.0
3.7
GHz
40°/inch

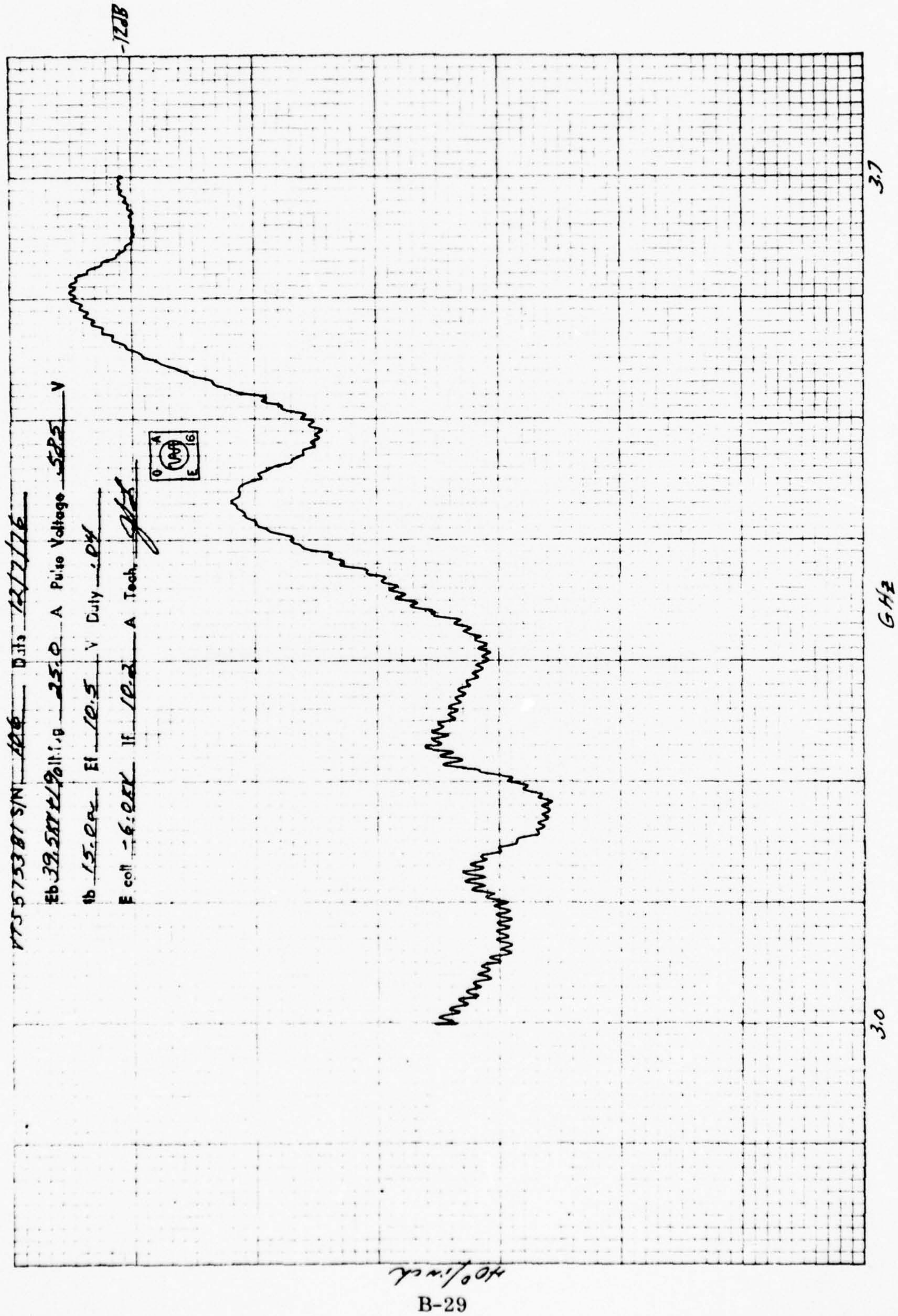

VTS5753B1 S/N 106 Date
Eb 39.5KV+1% IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ei 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech
+3dB
3.0
GHz
3.7
40°/inch


S/N 106
Date 12/2/76
Eb
Mag 25.0 A
Pulse Voltage
V
ib 15.0A
Ef 10.5 V
Duty .04
E coll -6.0KV
If 10.2 A
Tech
GHz
2.0
3.7
40°/inch


VF33753B1 S/N 106 Date 12/7/76
Eb 39.5kV ±1% Ib 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 v Duty .04
E coll -6.0kV If 10.2 A Tech.
-3dB
3.0
GHz
3.7
.04/inch

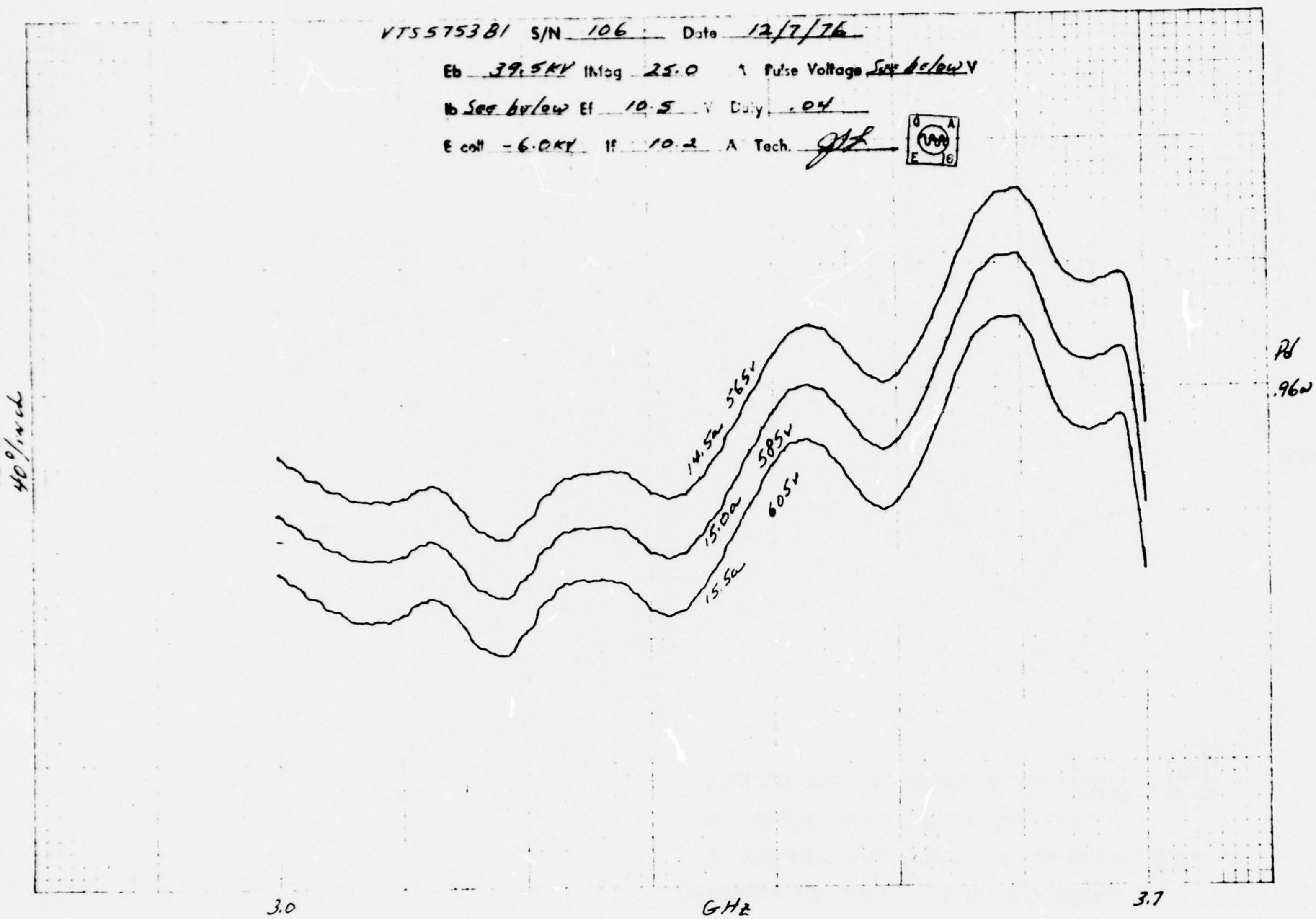

VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV ± 1/90 IM = 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 I Ely .04
E coll -6.0KV If 10.2 A Tech.
-6dB
3.0
3.7
GHz
40°/inch

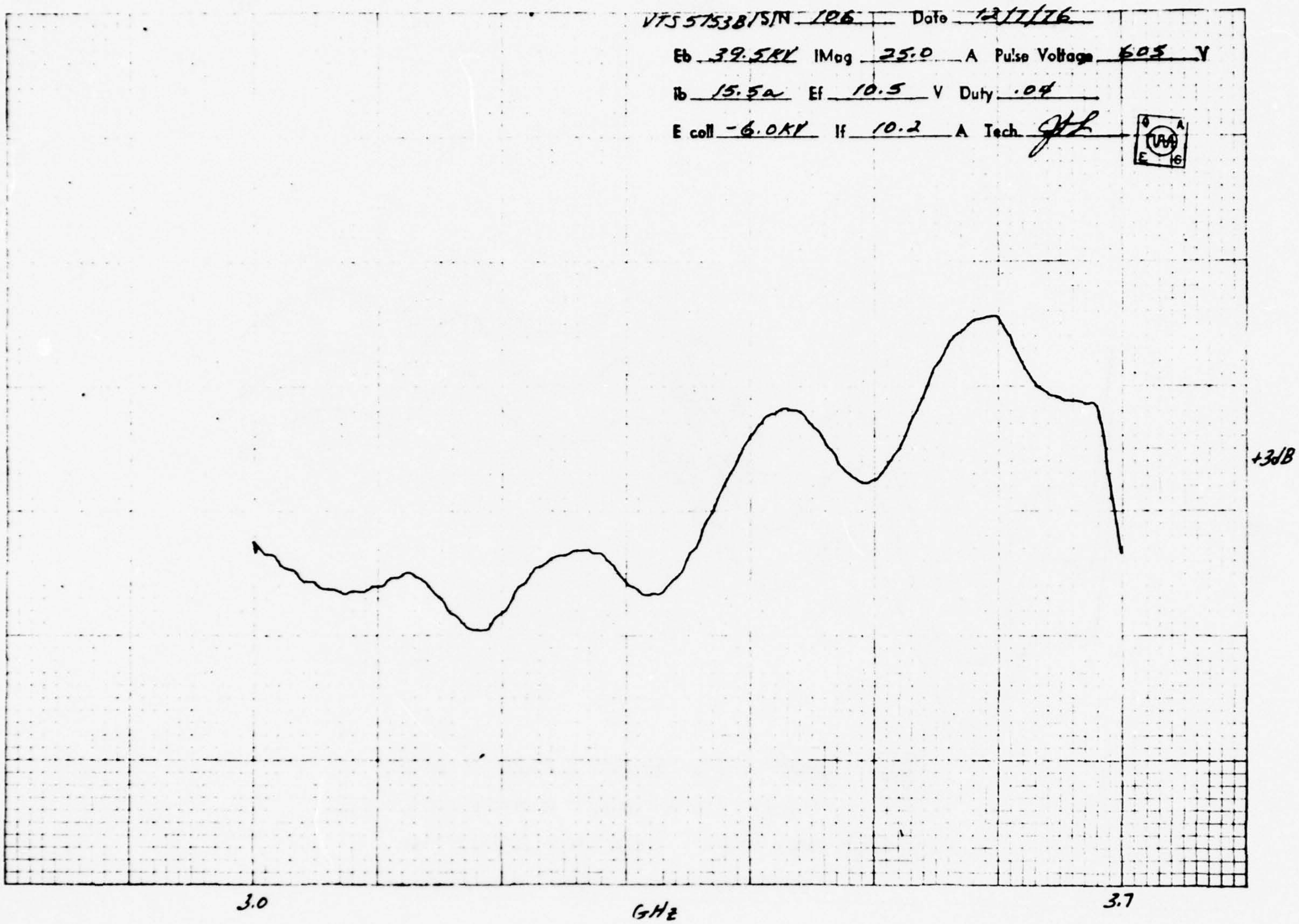

3.7
3.0
GHz
40°/inch



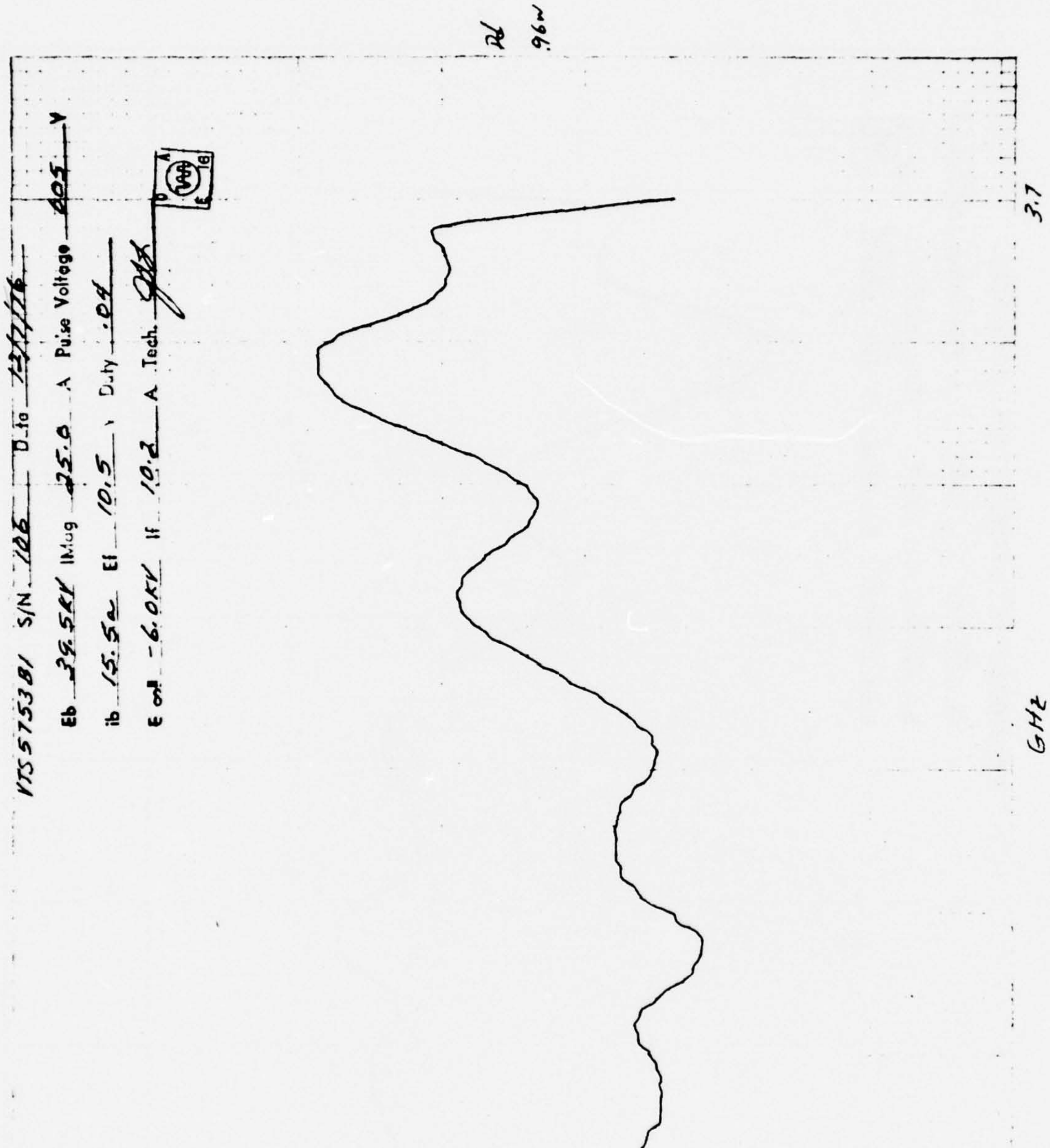
VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV ±1% Ib 25.0 A Pulse Voltage 5KV V
Ib 15.0 Eh 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
-12dB
3.0
3.7
GHz
40°/inch

4. Phase pushing with ±3% change in beam current

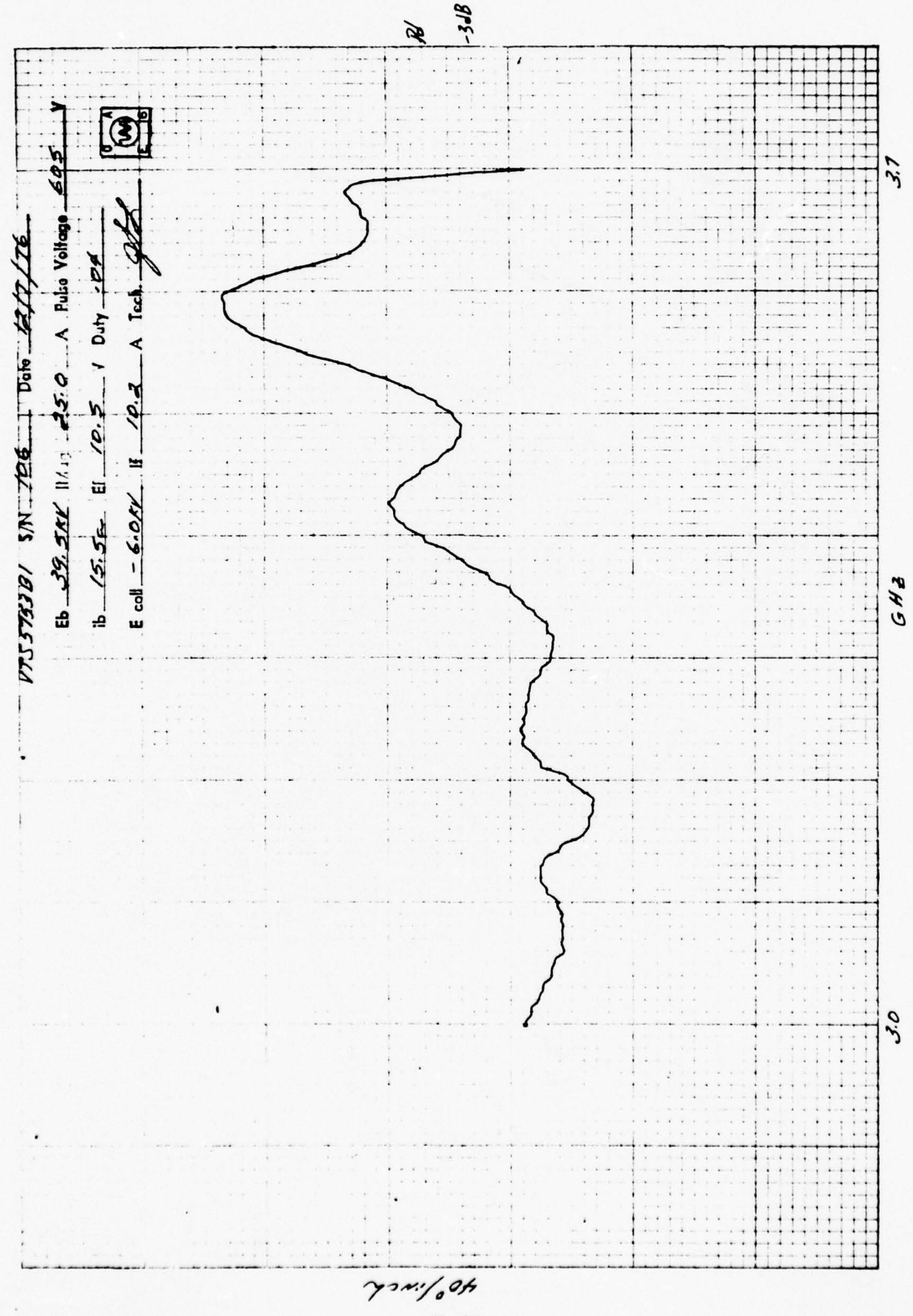

VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage See below V
Ib See below Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
14.5a 565v
15.0a 585v
15.5a 605v
Pd
.96w
3.0
GHz
3.7
40%/inch

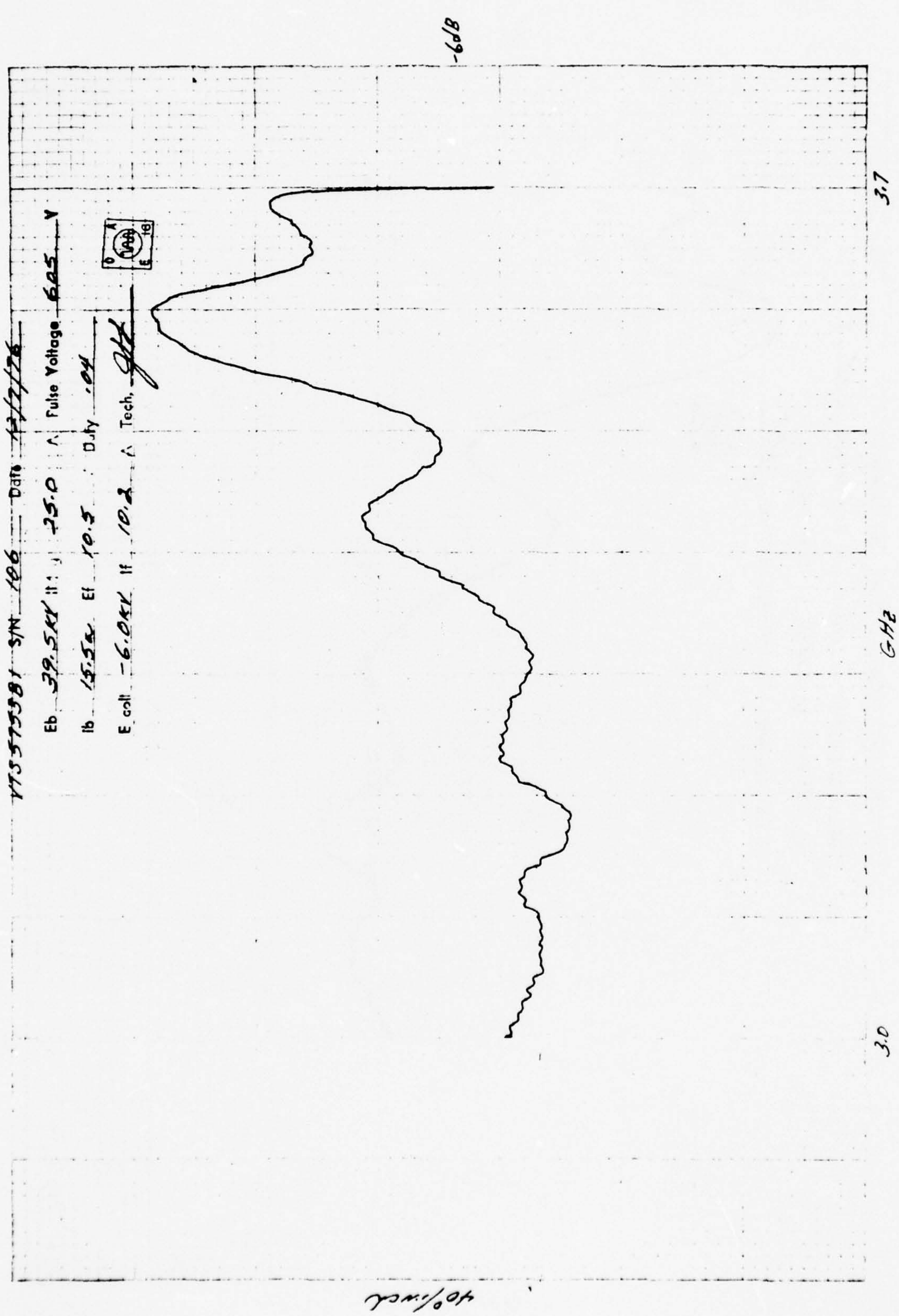

VTS 5753B S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 605 V
Ib 15.5a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech
+3dB
3.0
GHz
3.7

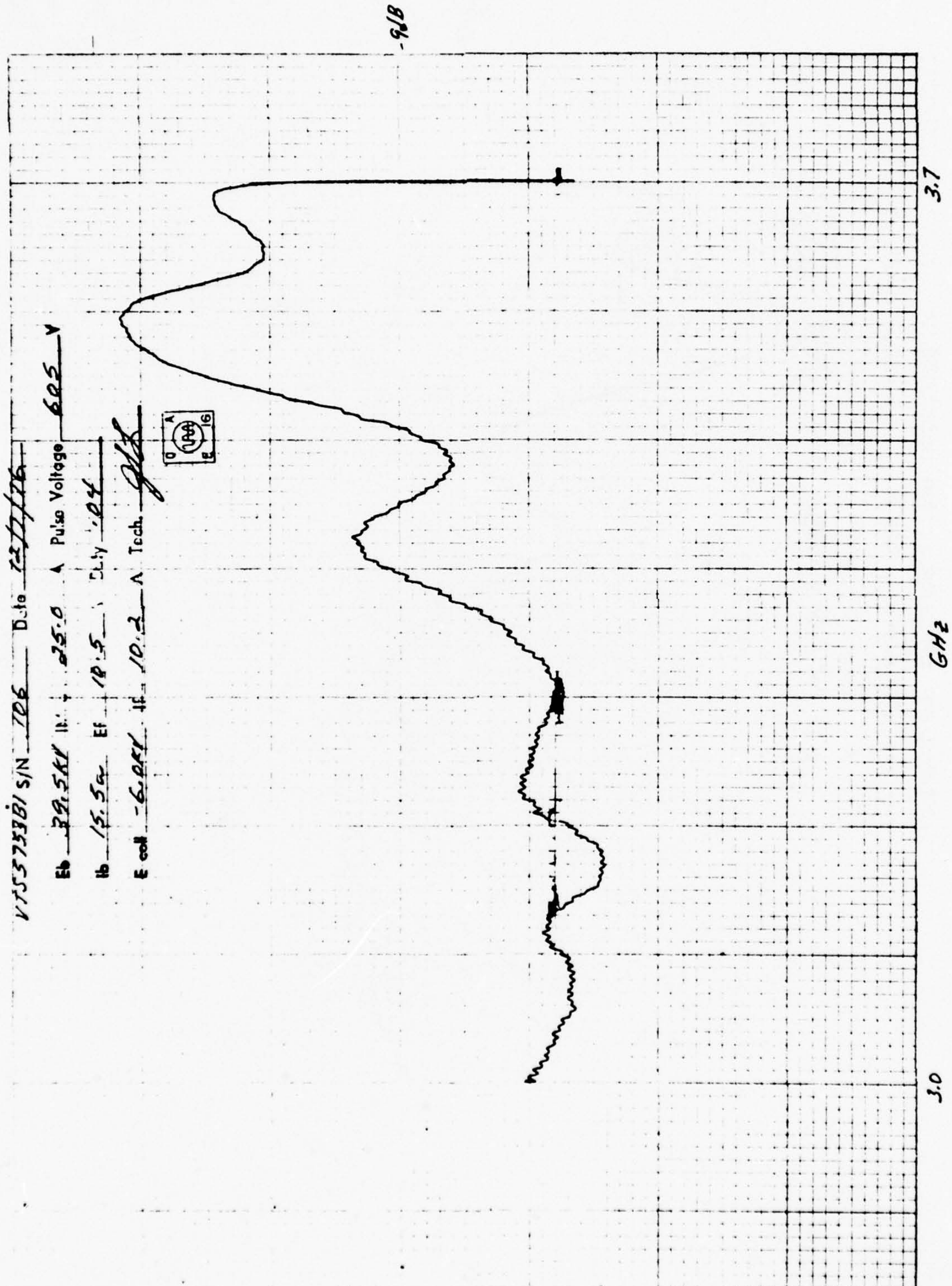
400/inch

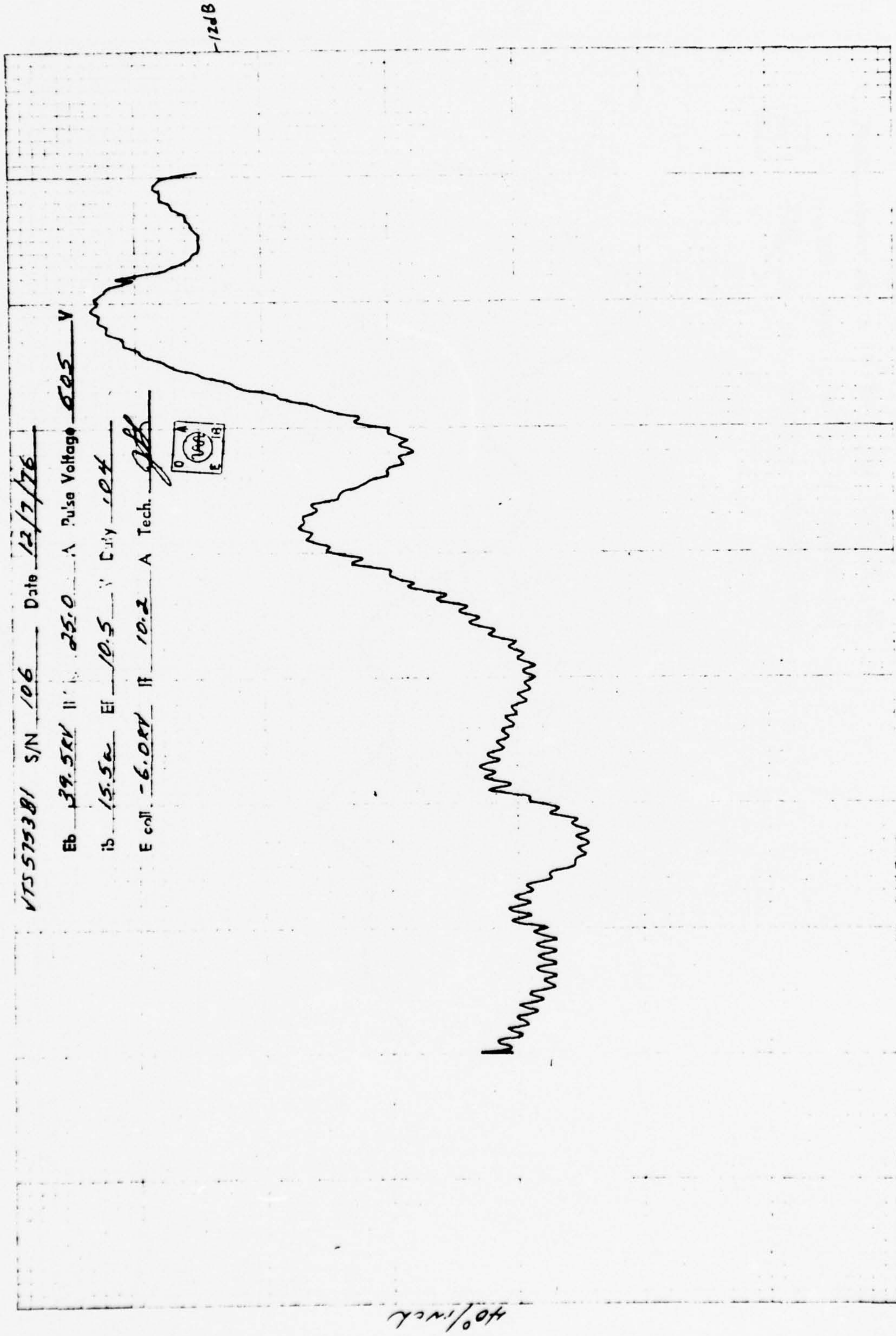


VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 805 V
ib 15.5a Ef 10.5 V Duty .04
E on -6.0KV If 10.2 A Tech.
3.7
GHz
3.0
0
.96w

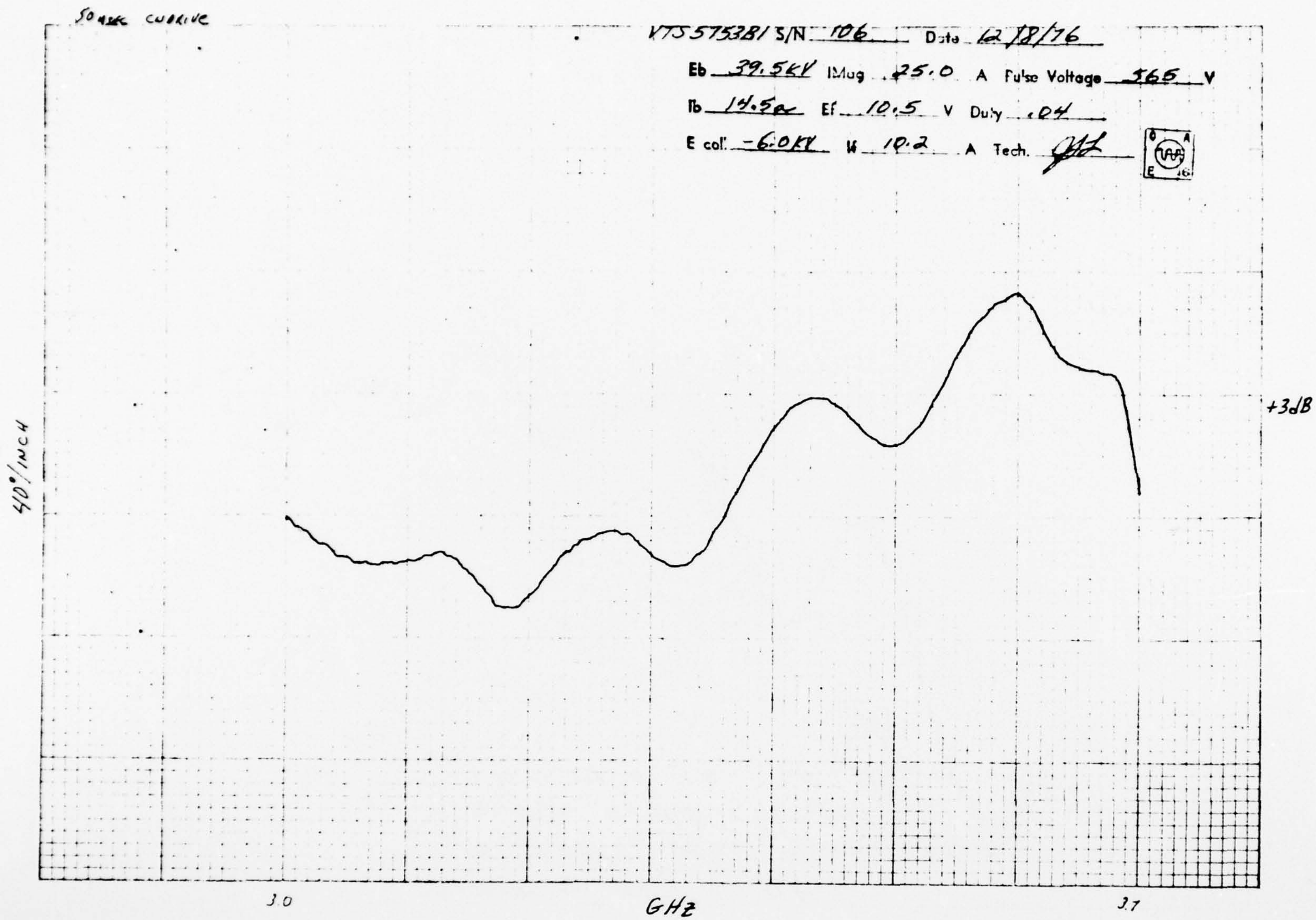

VTS5753B1 S/N 126 Date 12/17/76
Eb 39.5KV
A Pulse Voltage 605 V
El 10.5 V Duty
E coll -6.0KV If 10.2 A Tech.
3.0
GHz
3.1
-3dB
40°/inch


S/N 106 Date
Eb 39.5KV 25.0 Pulse Voltage 6.05 V
Ib 15.5A Ef 10.5 Duty .04
E coll -6.0KV If 10.8 Tech,
-6dB
3.7
GHz
3.0
40°/inch


VA553753B1 S/N 706 Date
Eb 39.5KV Ib 25.0 A Pulse Voltage 605 V
If 15.5a Ef 10.5 Duty .04
E coll -6.0KV Ic 10.2 A Tech.
-9dB
3.0
GHz
3.7
40°/inch



VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV Ib 25.0 A Pulse Voltage 505 V
ib 15.5a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
-12dB
3.0
3.7
GHz
40°/inch



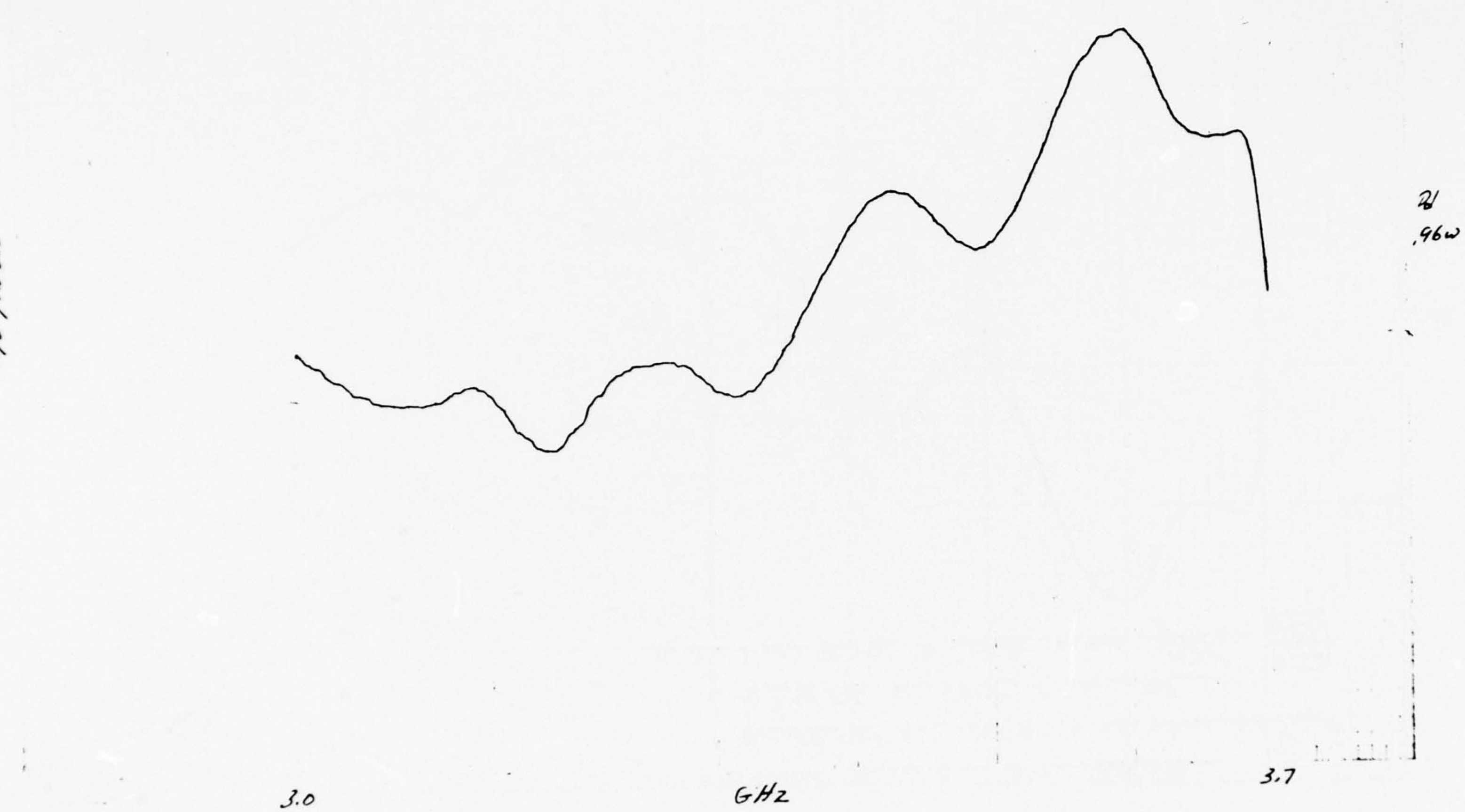
SO ASEC CURVE
VTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V
Ib 14.5a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
+3dB
3.0
GHz
3.7
40°/INCH

VTS5753B1 S/N 106 Date 12/8/76

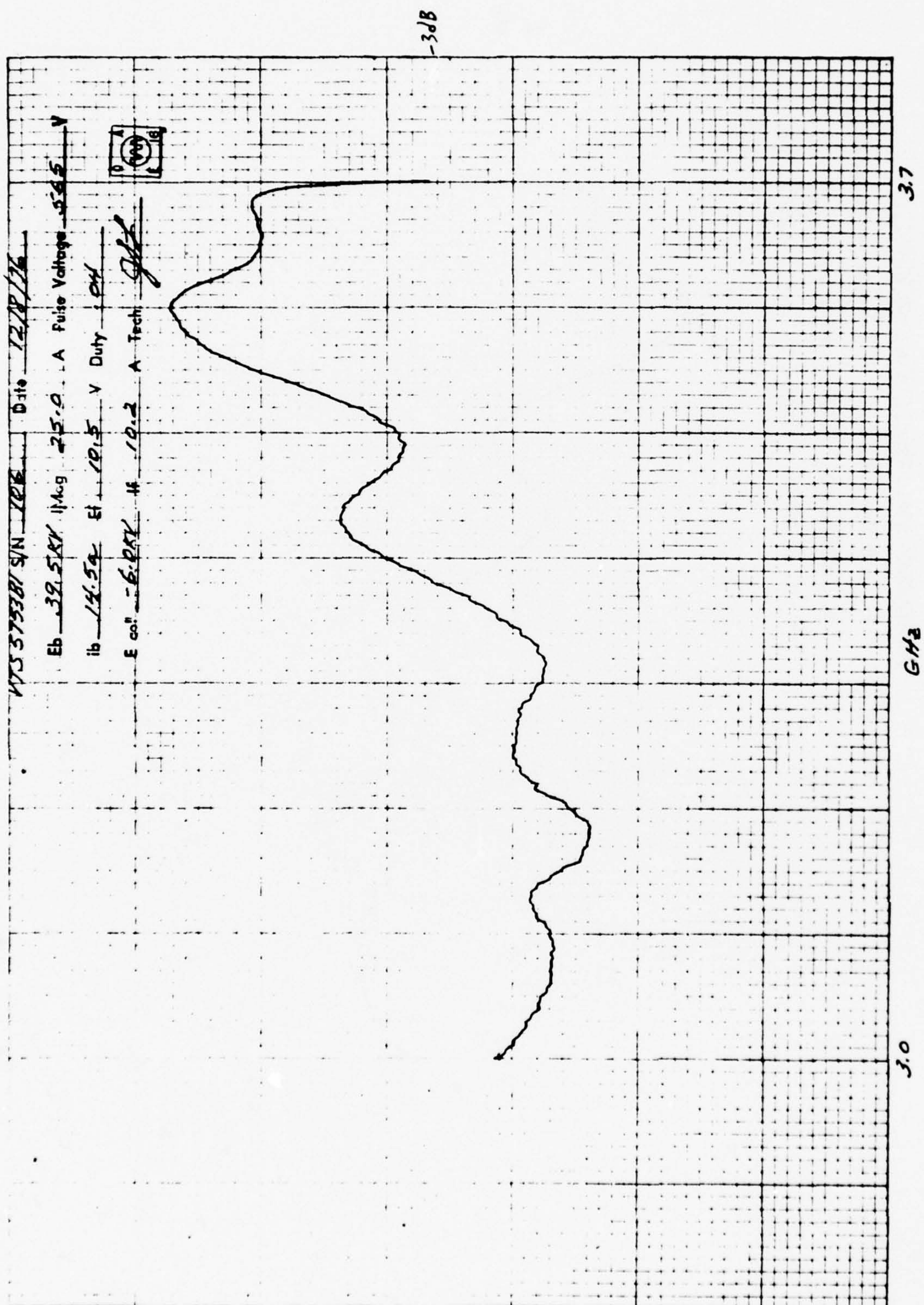
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V

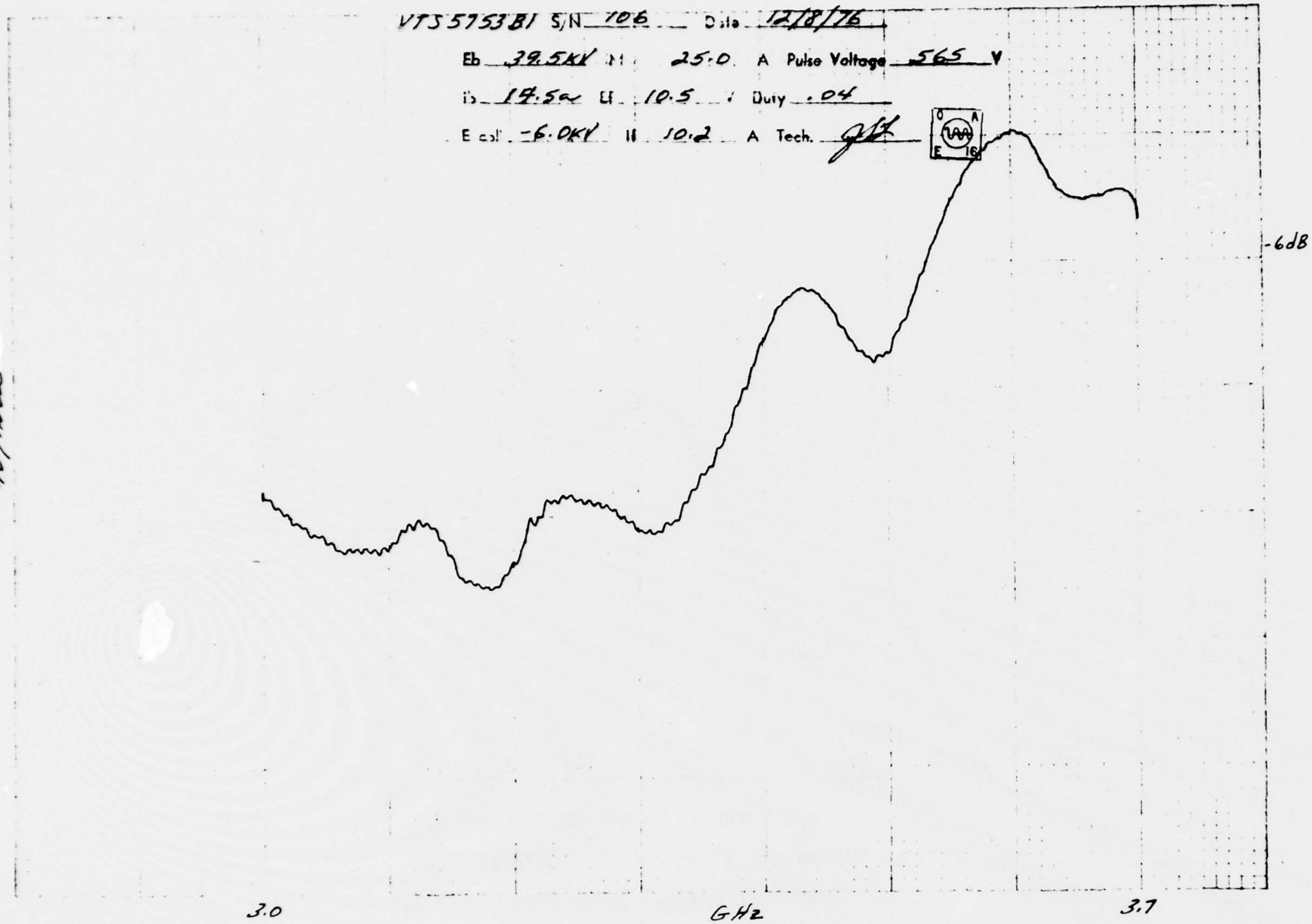
ib 14.5a Ef 10.5 V Duty .04

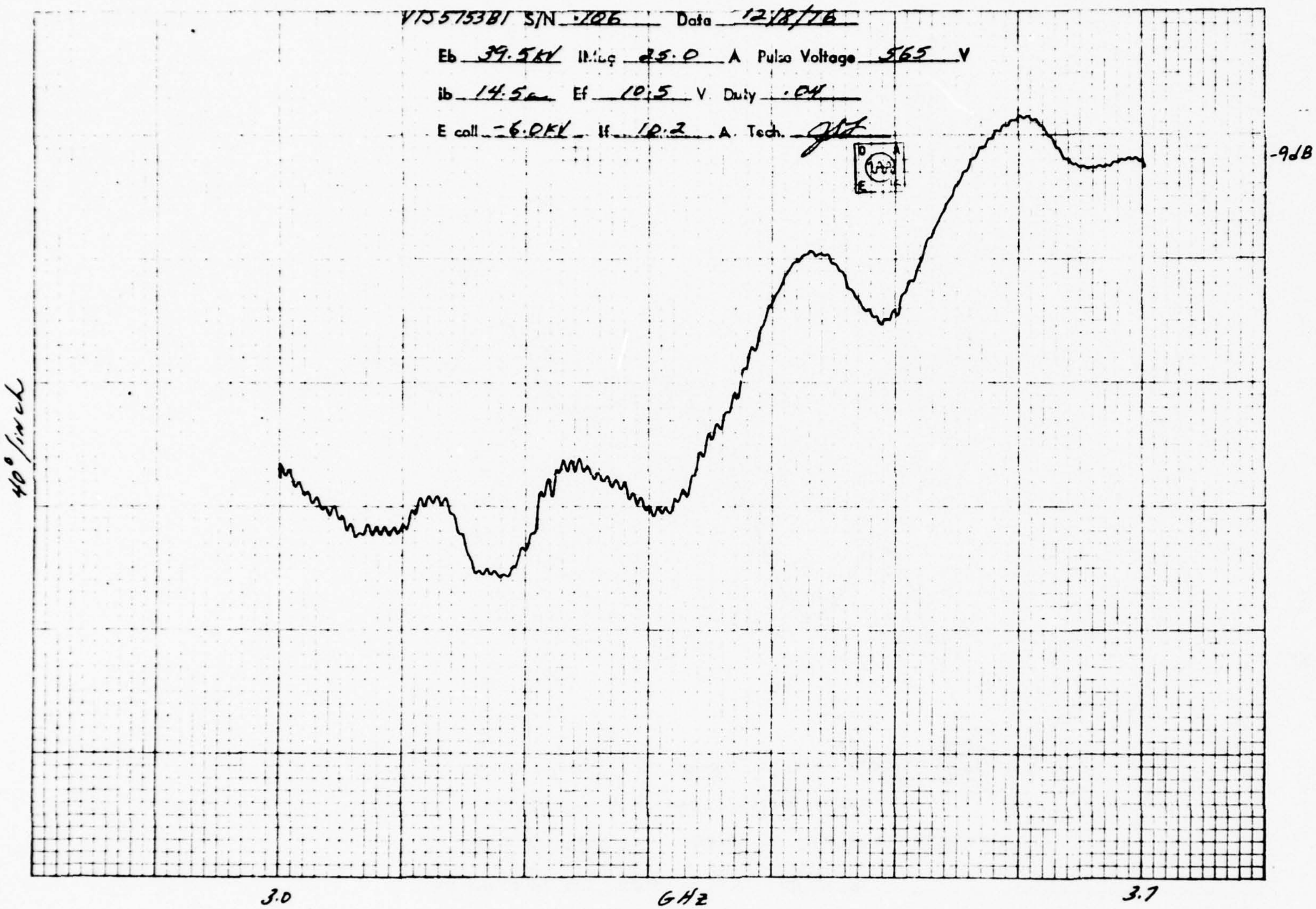
E coll -6.0KV If 10.2 A Tech. gfd

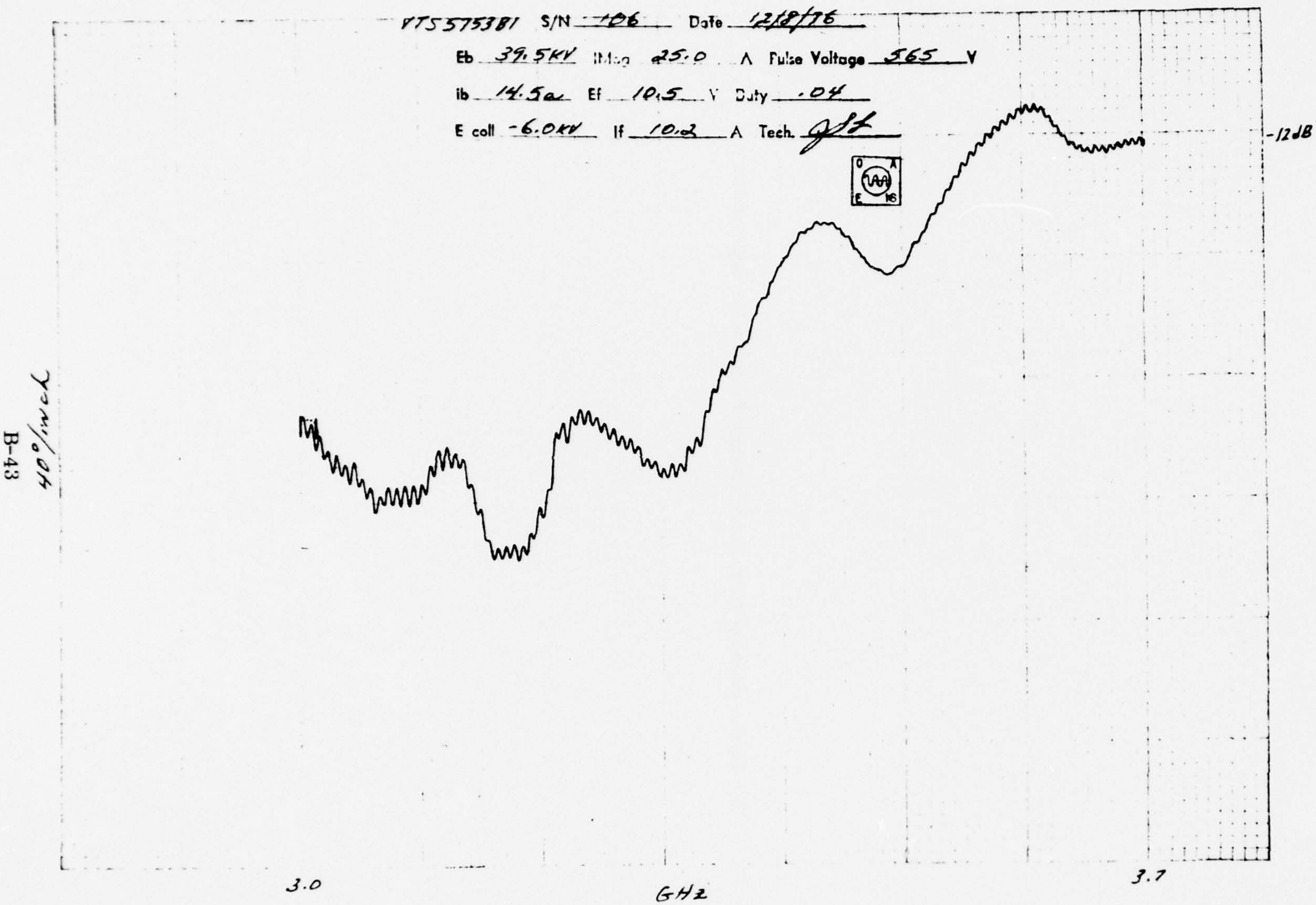


40°/inch

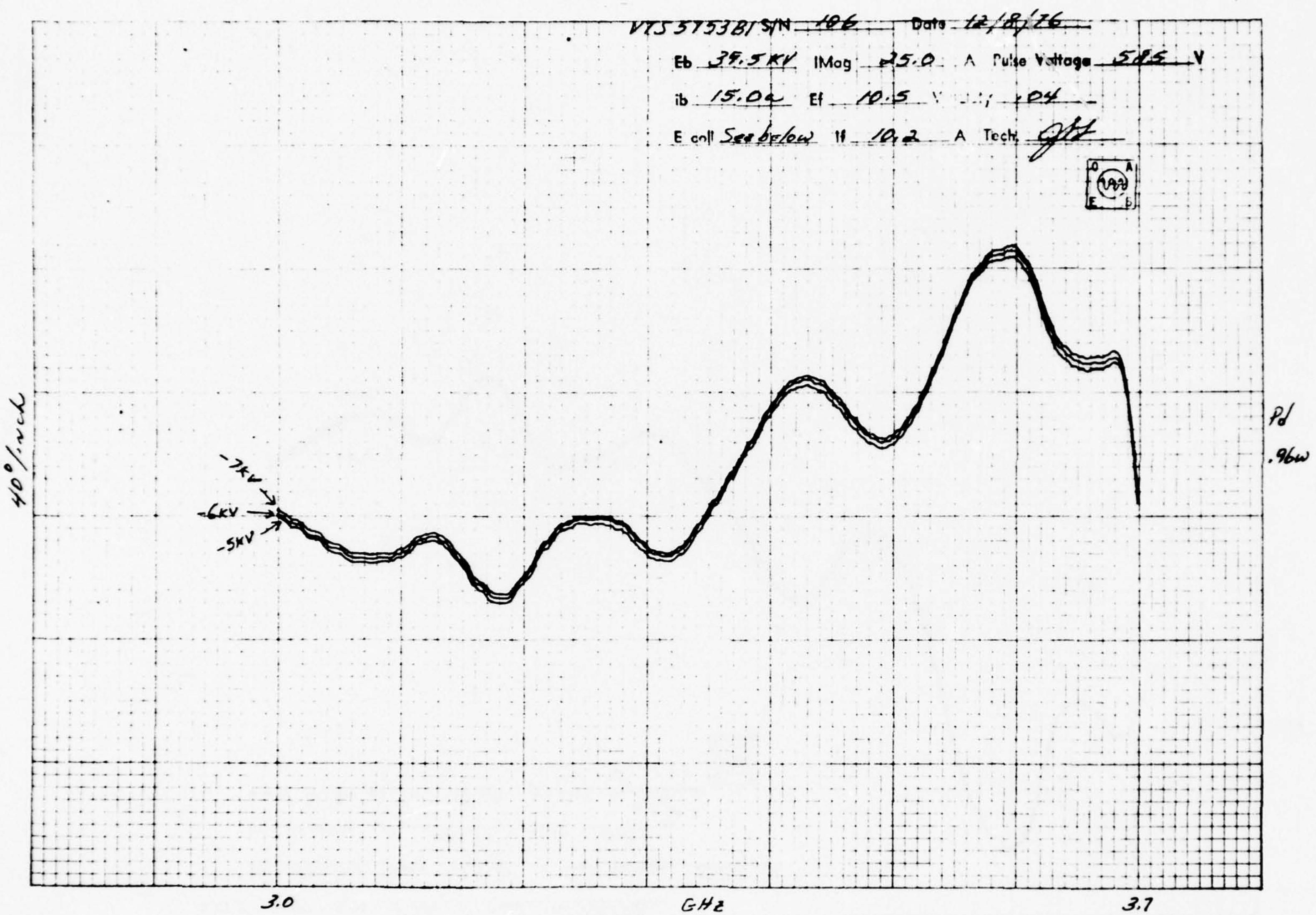

VTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V
ib 14.5a Ef 10.5 V Duty .04
E col -6.0KV If 10.2 A Tech
-3dB
3.0
GHz
3.7

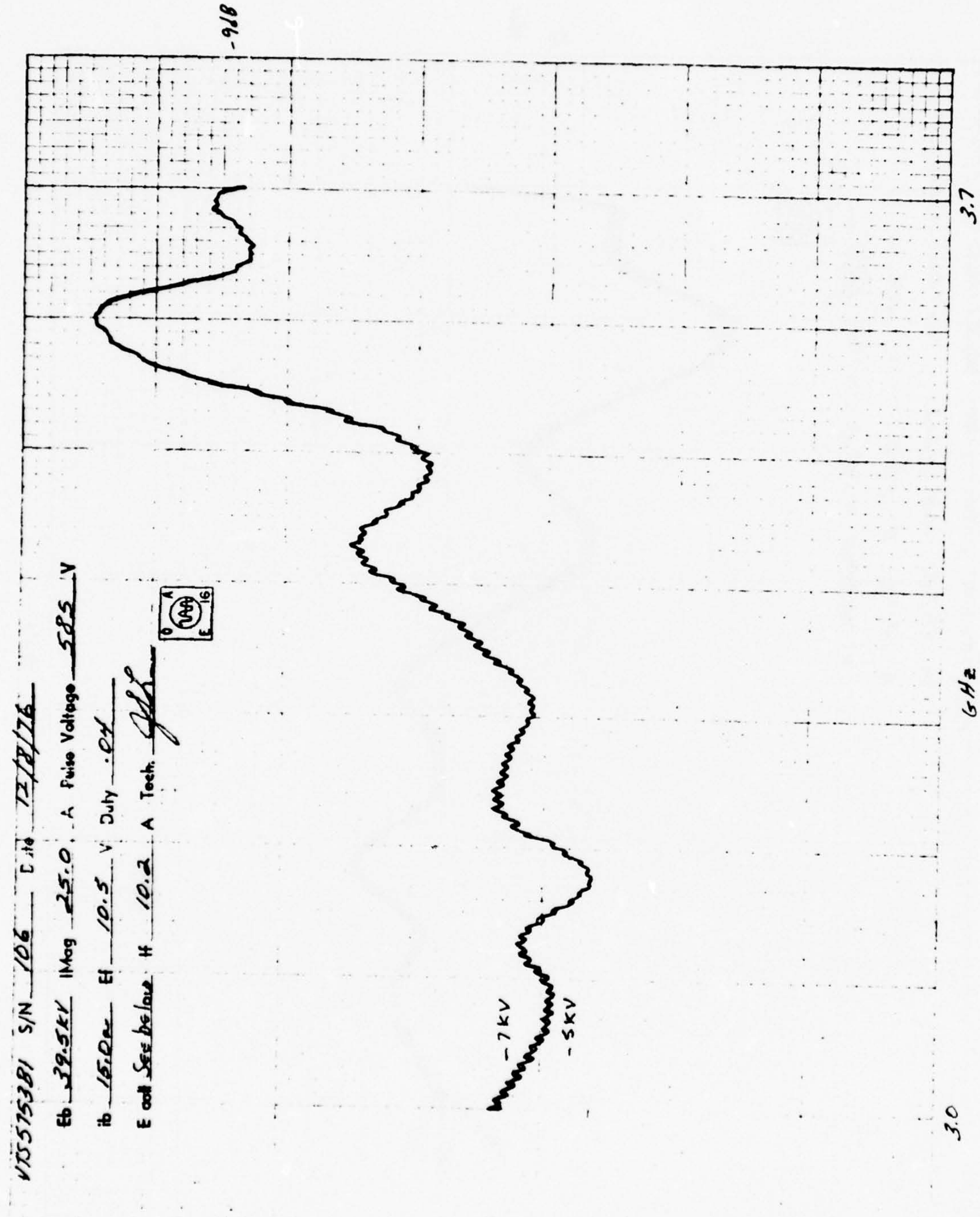

VTS5753B1 S/N 706 Date 12/8/76
Eb 39.5KV Ik 25.0 A Pulse Voltage 565 V
ib 14.5a Ef 10.5 Duty .04
E col -6.0KV If 10.2 A Tech.
-6dB
3.0
GHz
3.7
40°/inch


VTS5753B1 S/N 706 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V
ib 14.5a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
-9dB
3.0
GHz
3.7
40°/inch

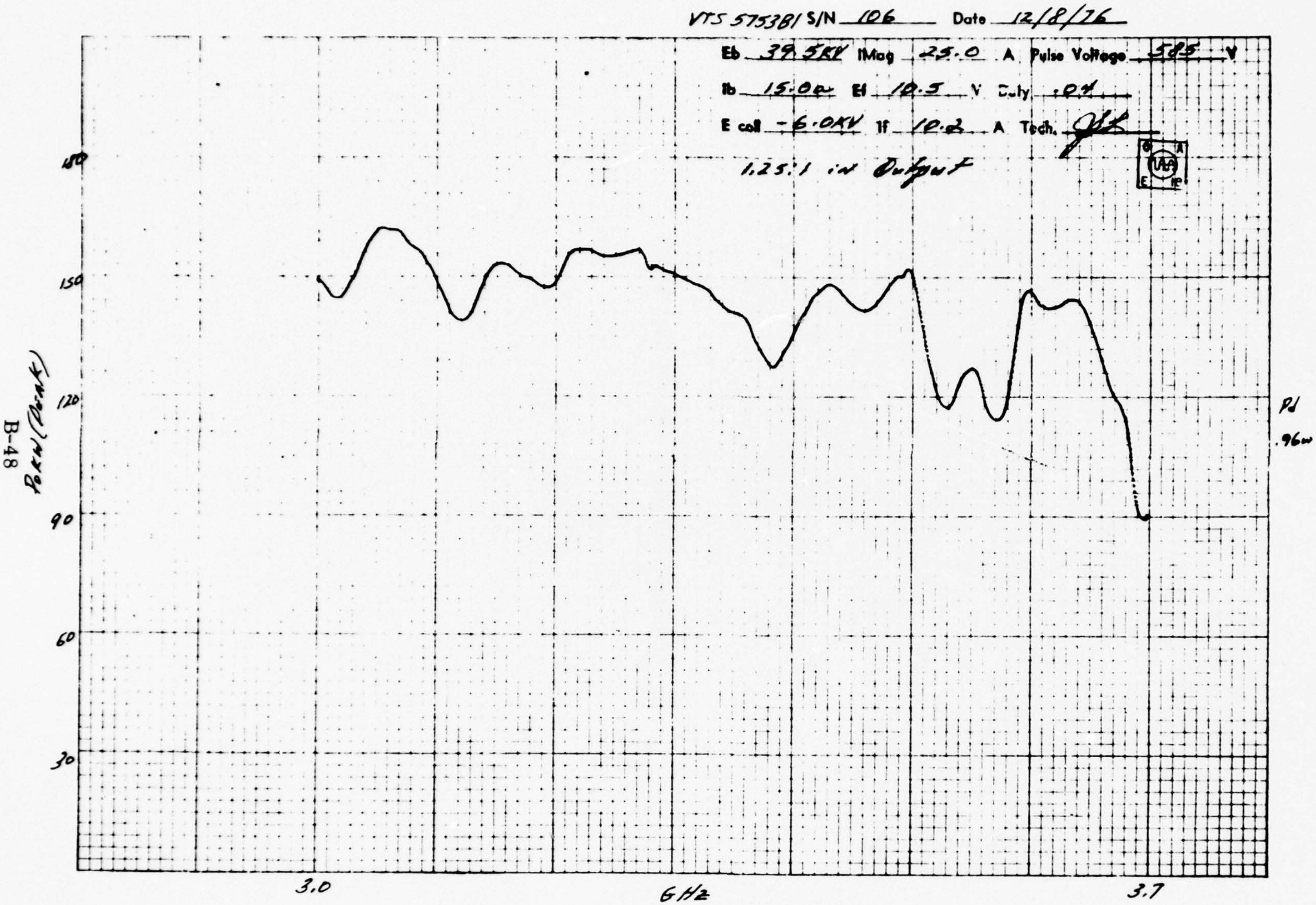

VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V
ib 14.5a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech. JSt
-12dB
3.0
GHz
3.7
40°/inch

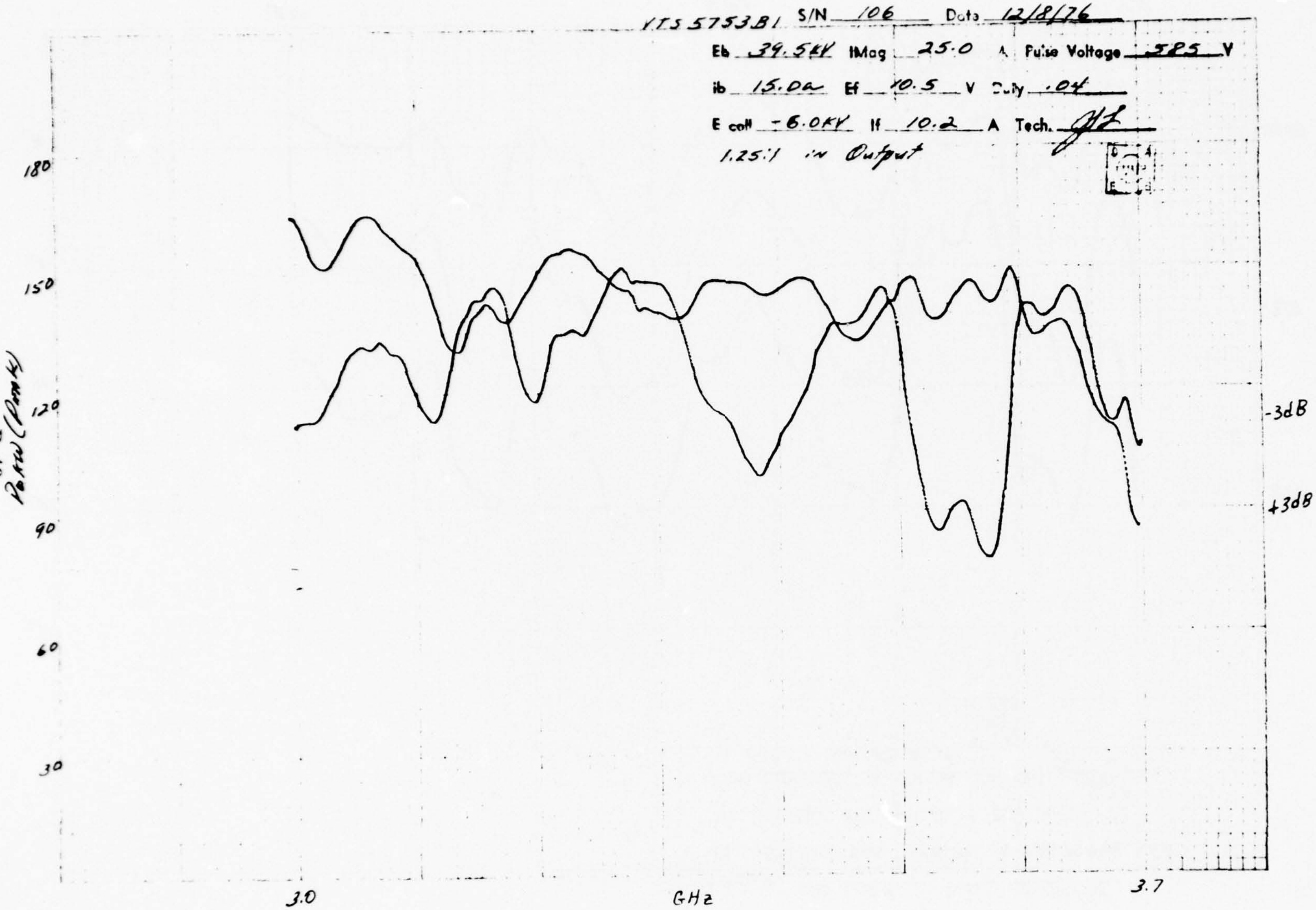
5. Phase pushing with ± 1 kV change in collector depression

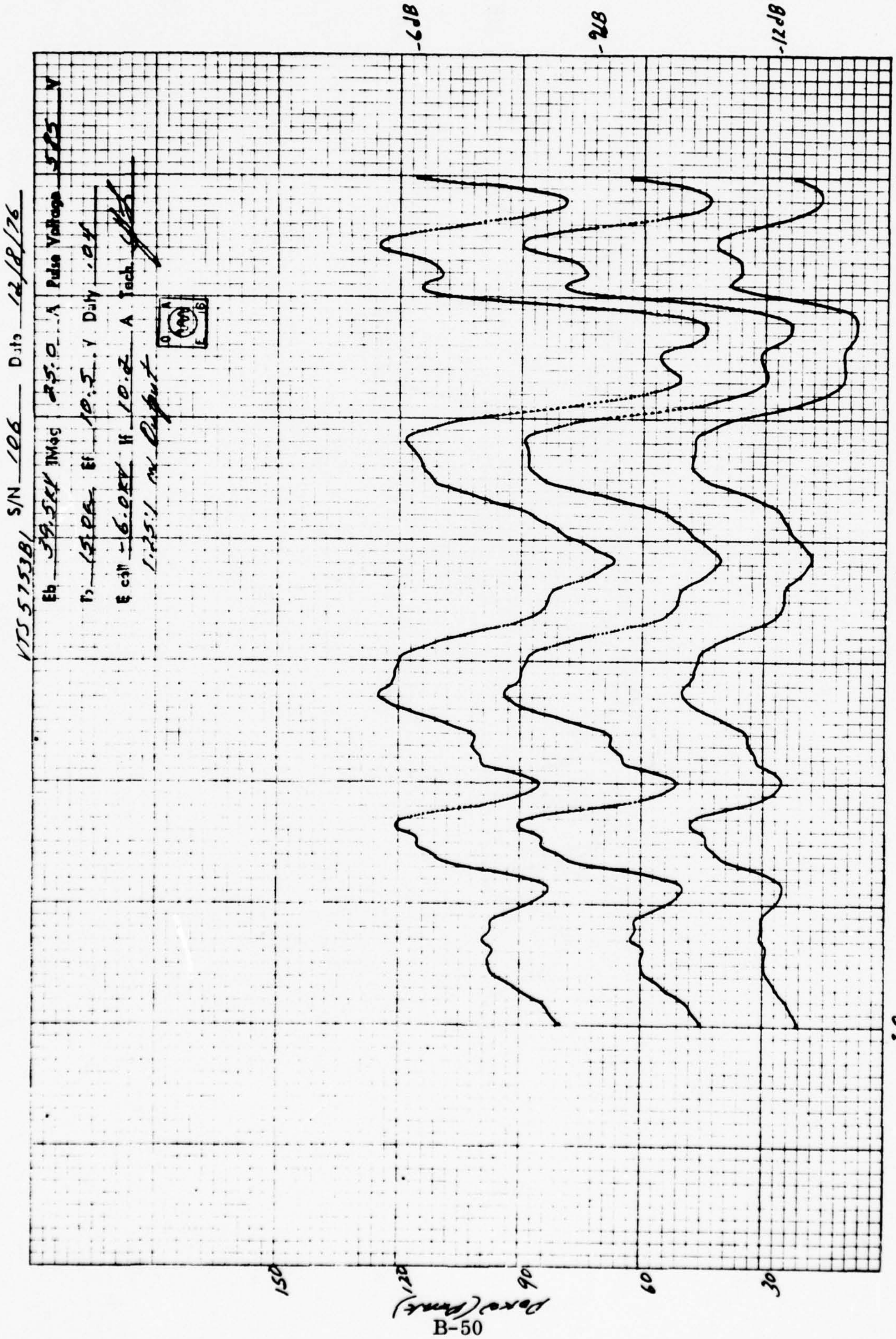

VTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5 KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 V
E coll See below If 10.2 A Tech
-7KV
-6KV
-5KV
Pd
.96w
40°/inch
3.0
GHz
3.7

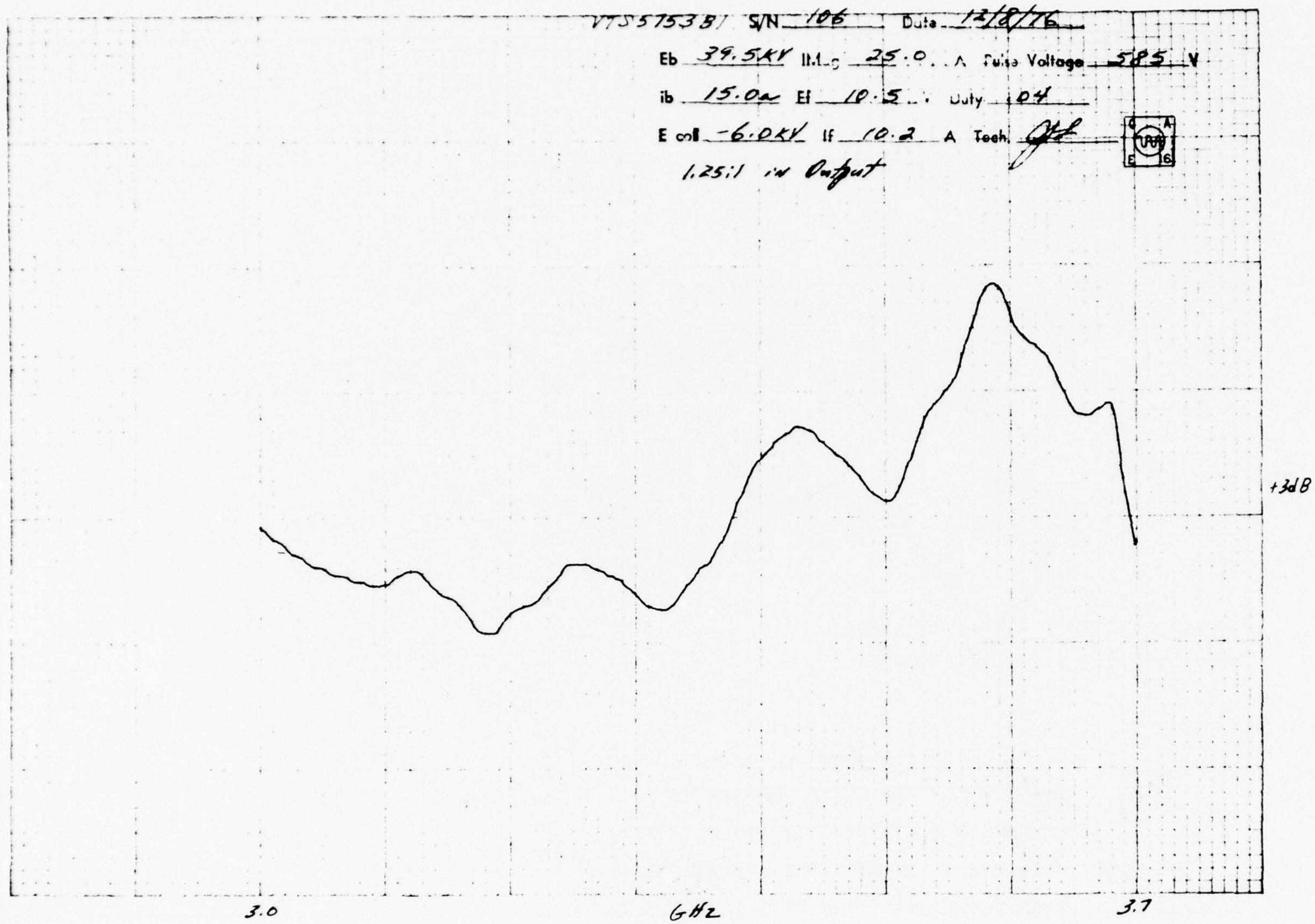

VT5575381 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0A Ef 10.5 V Duty .04
E coll See below If 10.2 A Tech.
-7KV
-5KV
-9dB
3.0
3.7
GHz
40°/inch

6. Amplitude and phase with a 1.25:1 VSWR

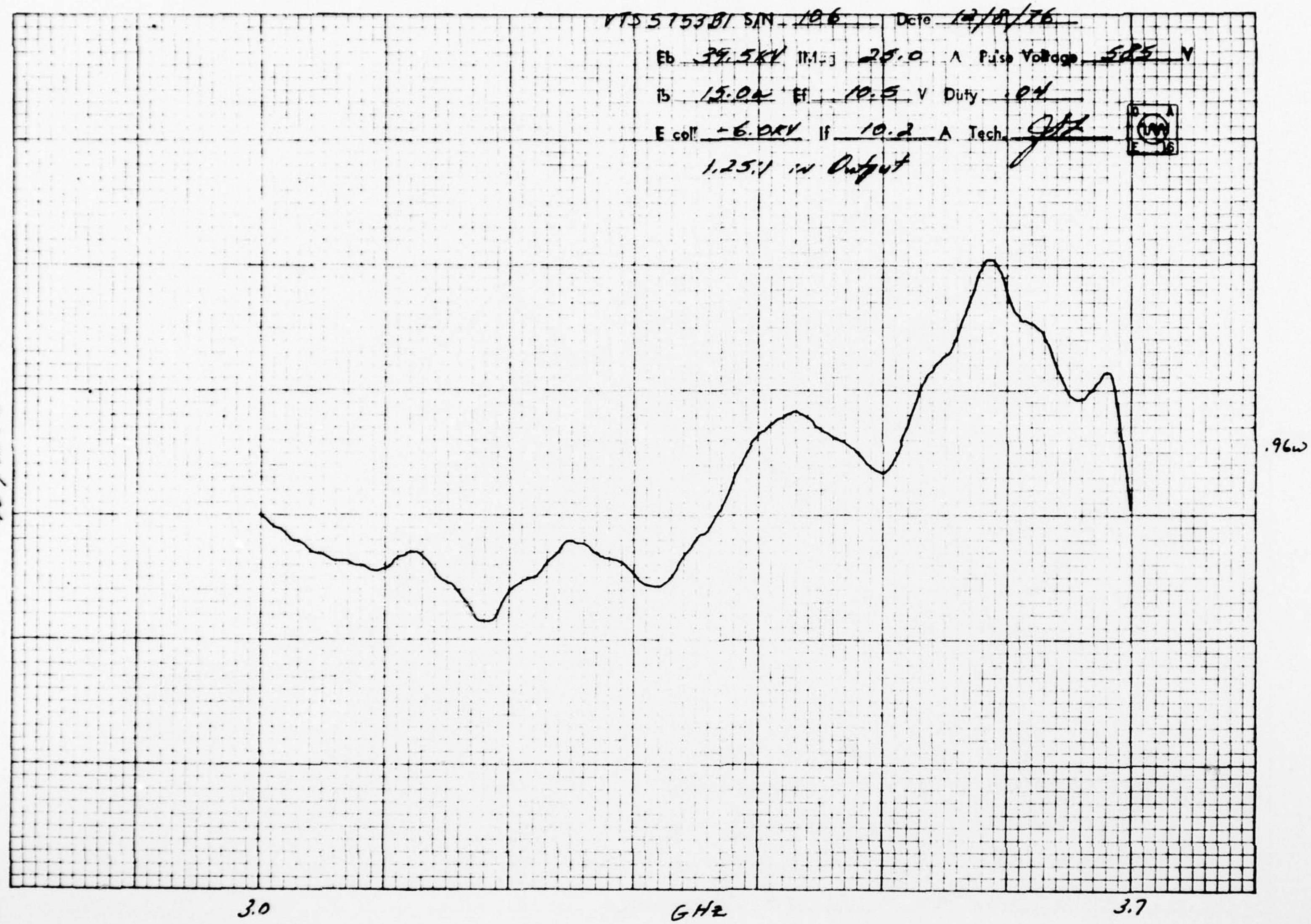

VTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
1.25:1 in Output
180
150
120
90
60
30
Po KW (Peak)
3.0
GHz
3.7
Pd
.96w


YTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
1.25:1 in Output
180
150
120
90
60
30
-3dB
+3dB
3.0
GHz
3.7

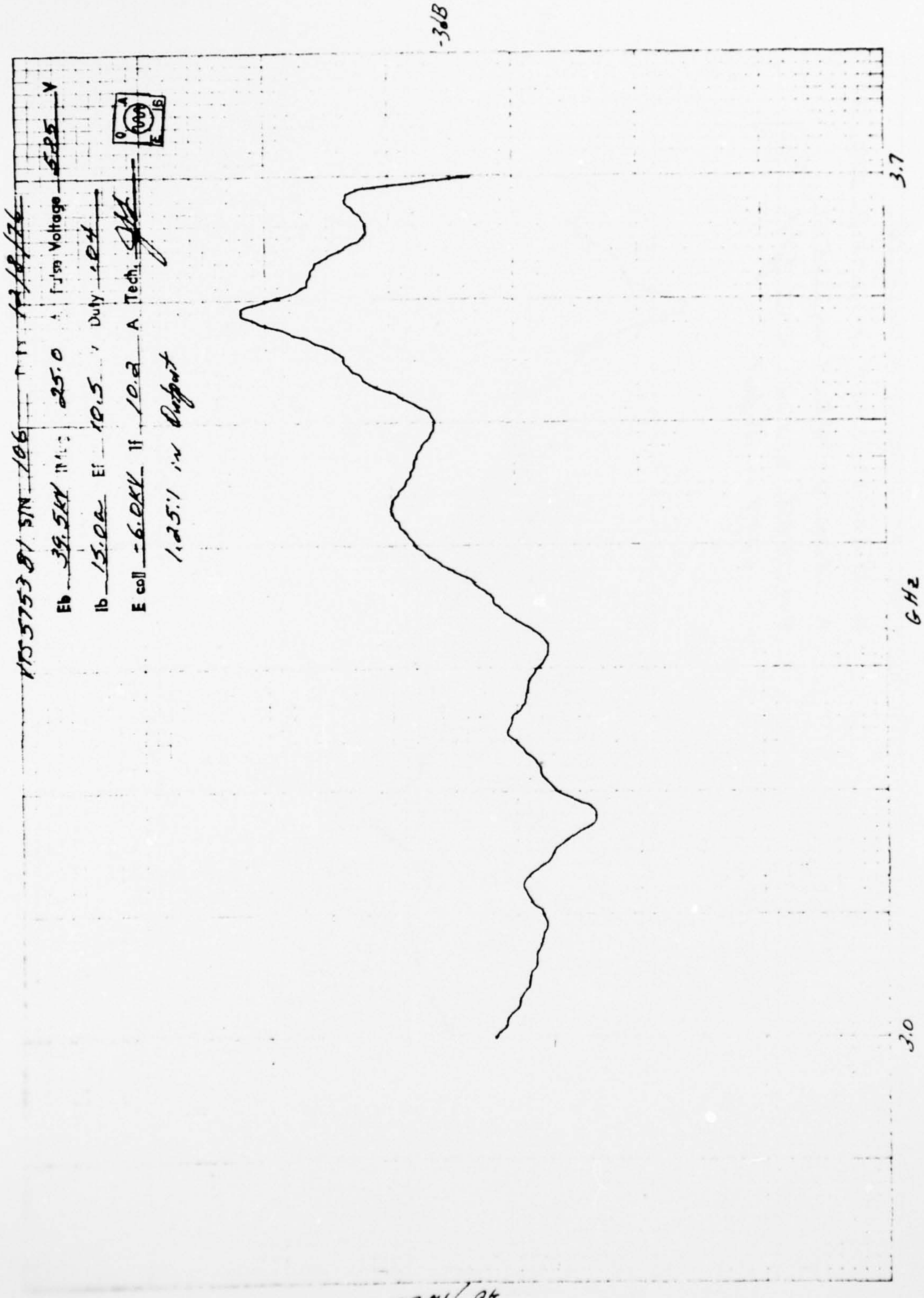

VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ts 15.0G Ef 10.5 V Duty .04
E c-a -6.0KV If 10.2 A Tech
1.25:1 on Output
-6dB
-9dB
-12dB
3.0
GHz
3.7
150
120
90
60
30

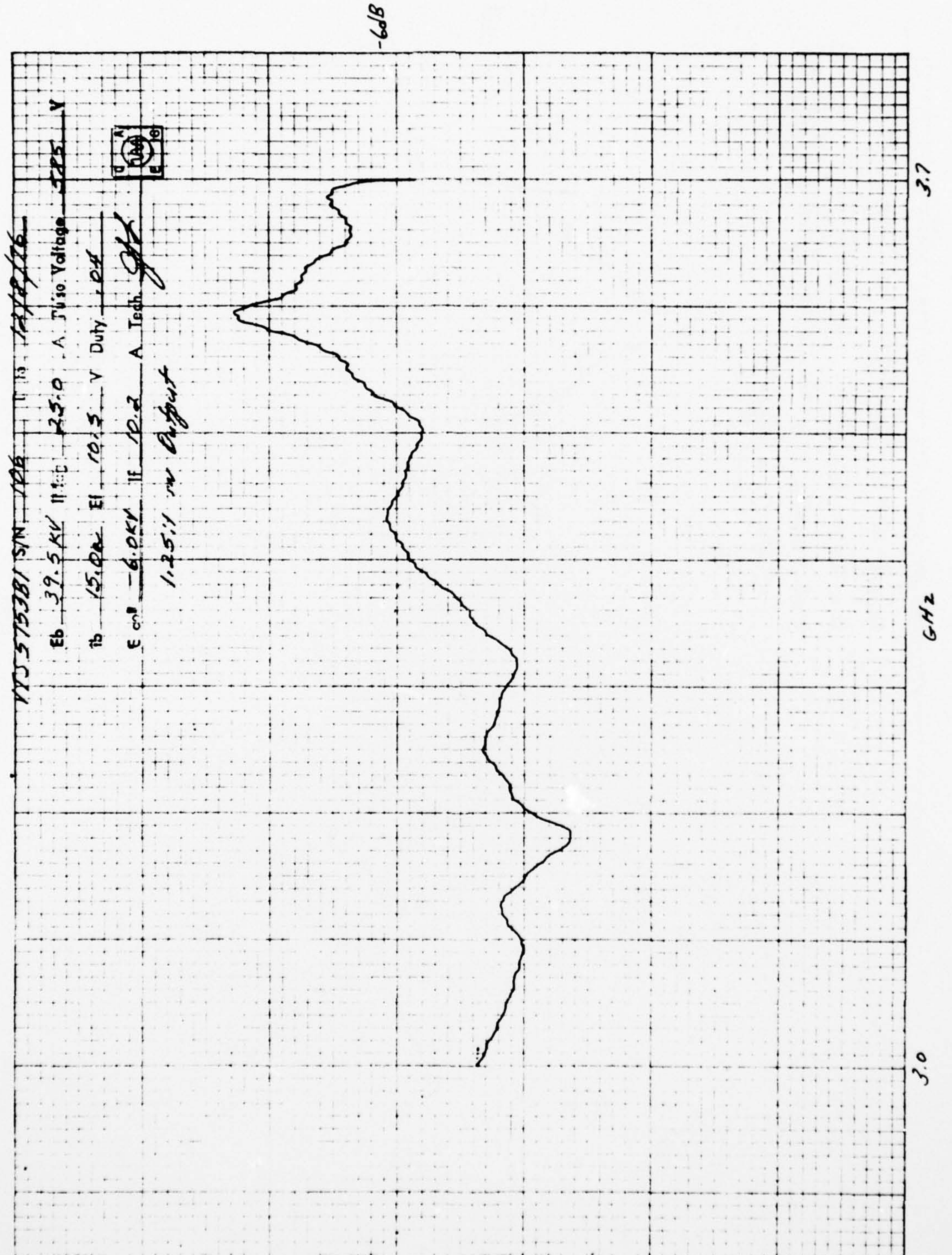

VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5KV 25.0 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 Duty .04
E coll -6.0KV If 10.2 A Tech.
1.25:1 in Output
+3dB
3.0
GHz
3.7

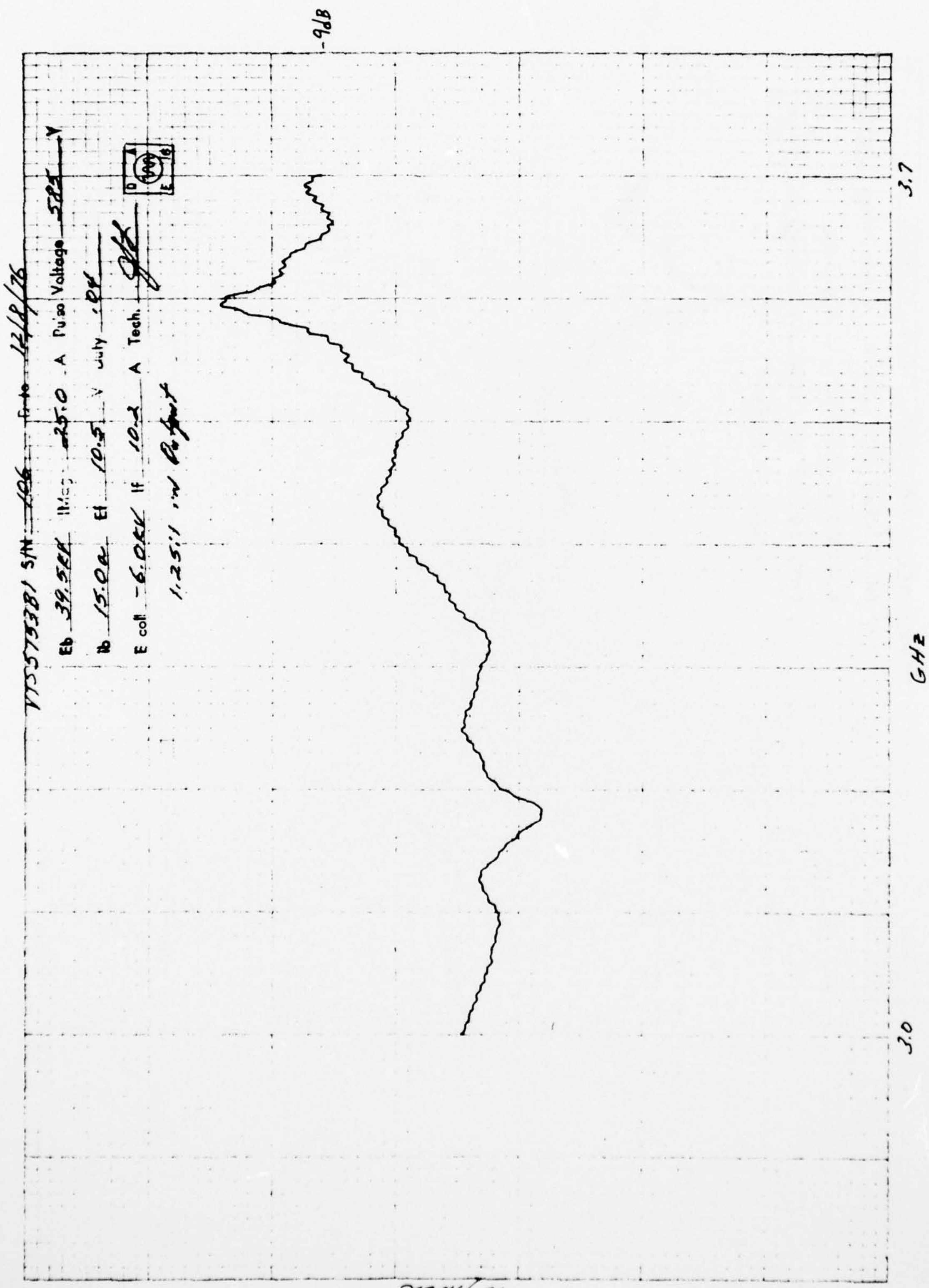
40°/inch

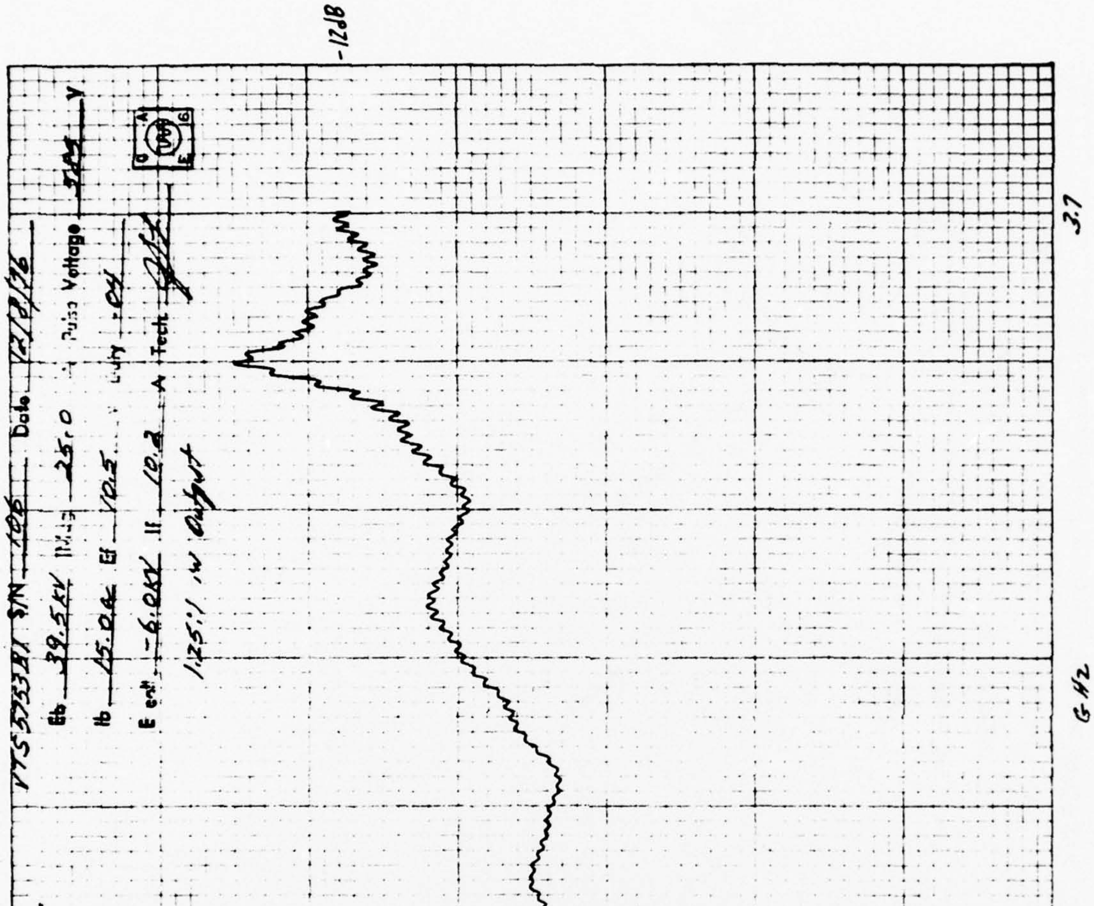

VTS5753B1 S/N 106 Date 12/8/76
Eb 34.5KV Ik.j 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech
1.25:1 in Output
.96w
3.0
GHz
3.7

40°/inch

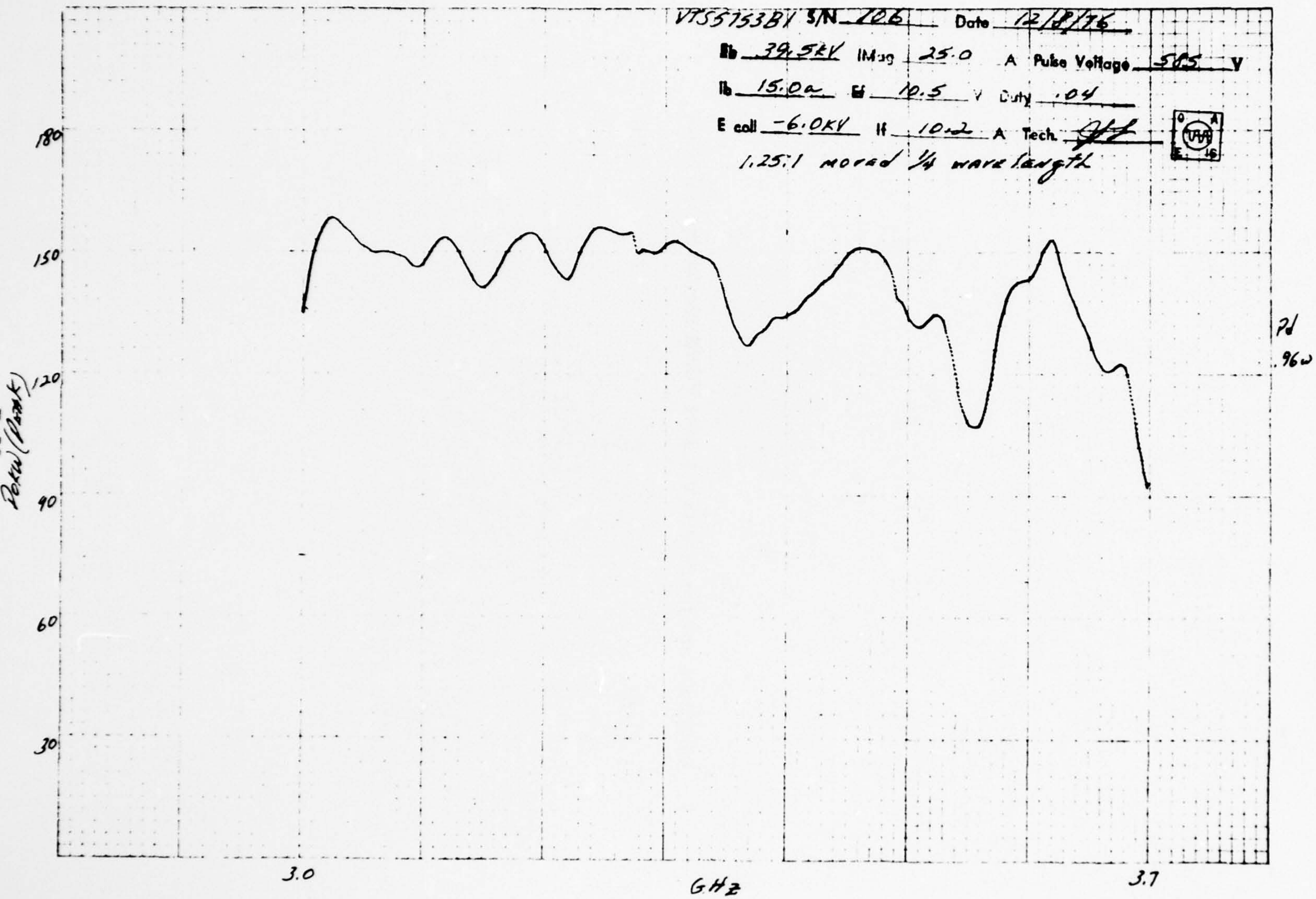

VTS 5753 B1 S/N 106 12/8/76
Eb 39.5KV 25.0 Pulse Voltage 5.25 V
Ib 15.0a Ef 10.5 Duty .04
E coll -6.0KV If 10.2 A Tech.
1.25:1 in Output
-3dB
3.0
GHz
3.7
40°/inch

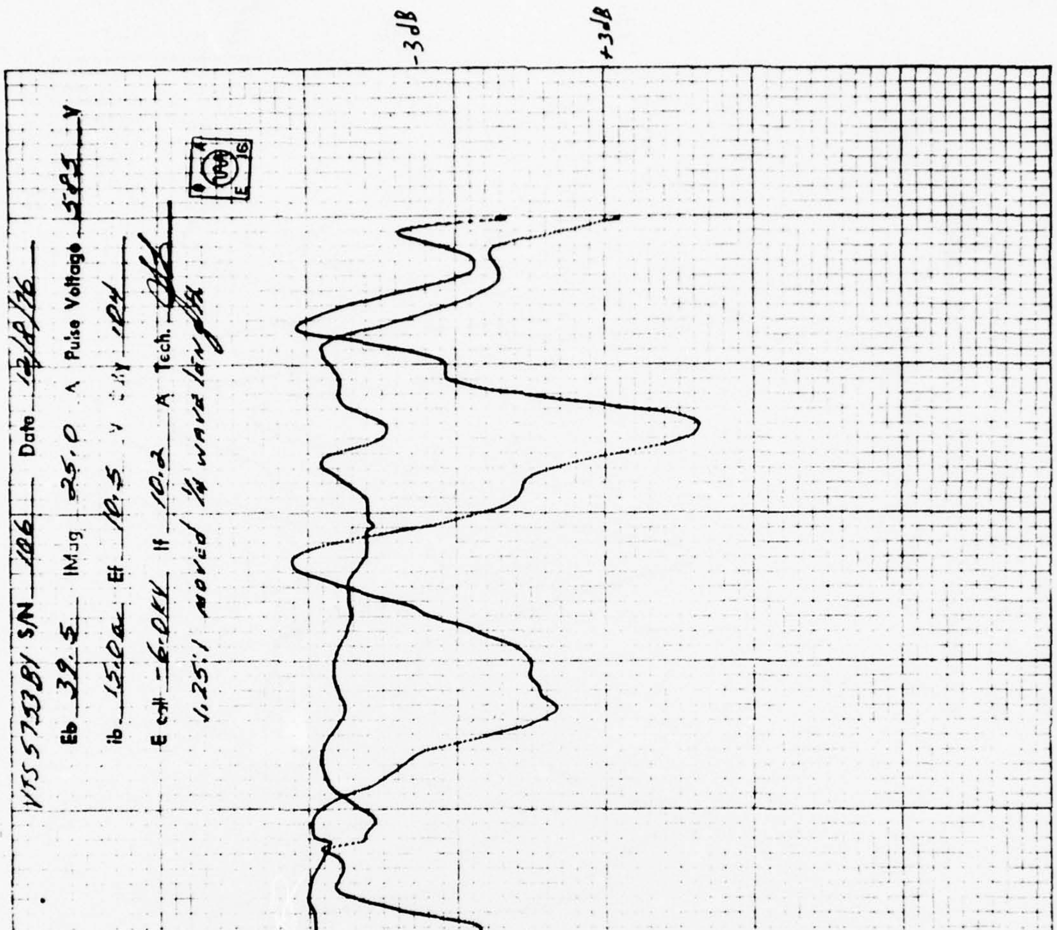

-6dB
GHz
3.0
3.7
Eb 39.5 KV
Ib 15.0 Adc
E coll -6.0 KV
1.25:1 on Output
Duty .04
Tech

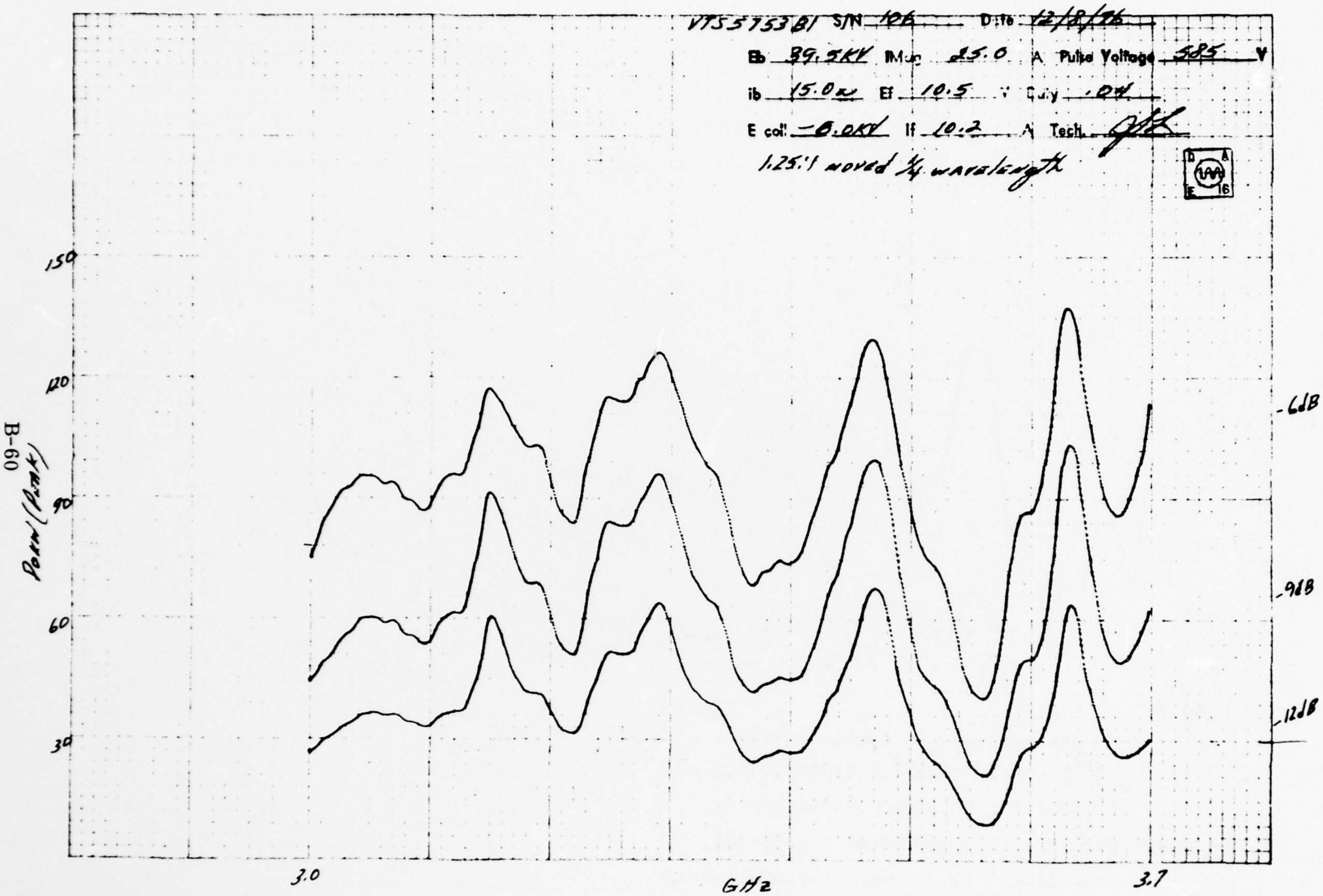

775573381 S/N 106
12/8/76
Eb 39.5KV
25.0 A Pulse Voltage
Ib 15.0A Ef 10.5 V Duty
E coll -6.0KV If 10.2 A Tech.
1.25:1 in Output
-9dB
3.7
GHz
3.0

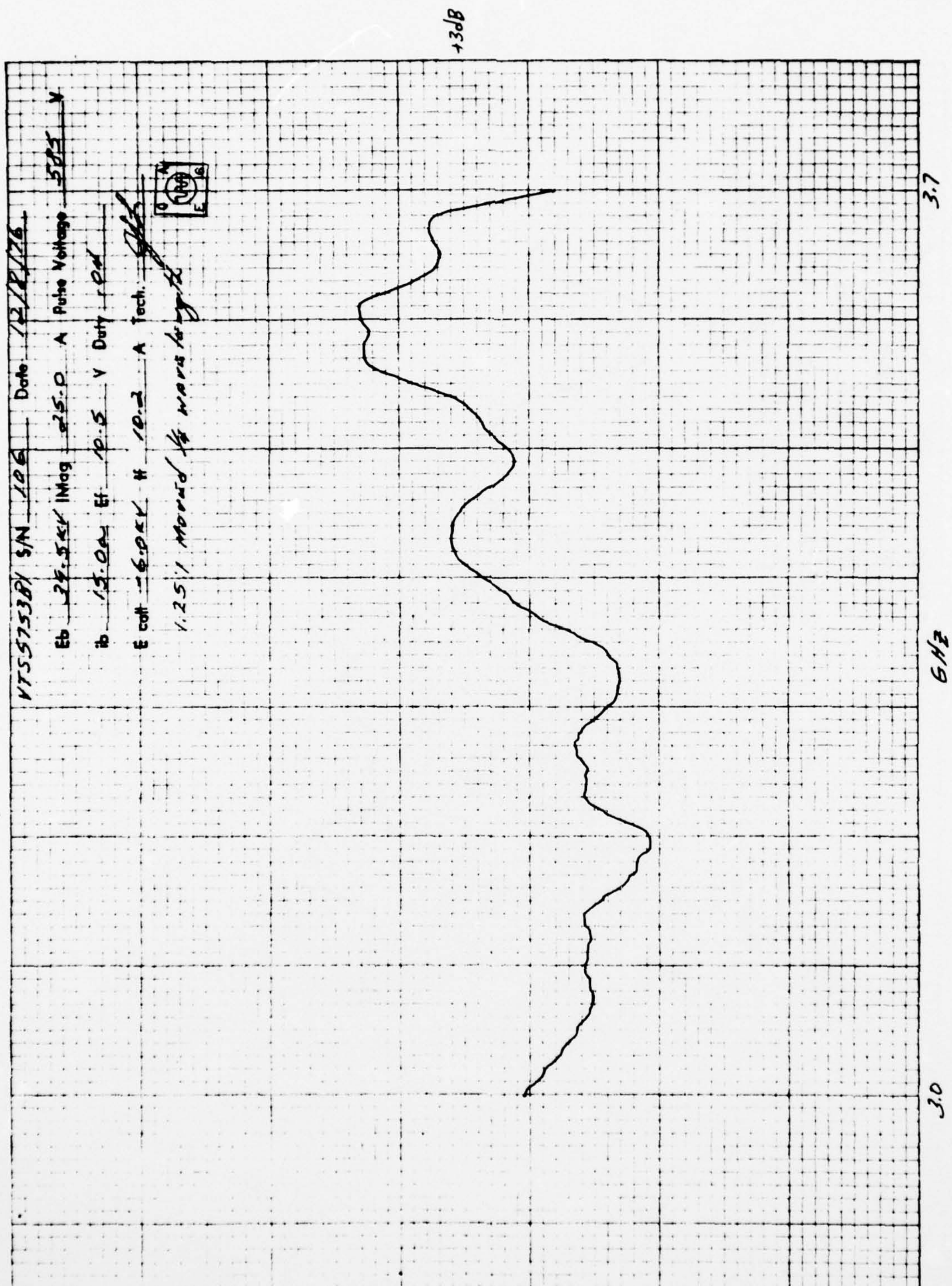

VTS5753A1 S/N 106 Date 12/8/76
Eb 39.5KV
Ib 15.0A
E coll -6.0KV
1.25:1 in Output
Pulse Voltage
Duty .04
Tech
-12dB
3.7
GHz
3.0
40°/inch

7. Amplitude and phase with a 1.25:1 VSWR shifted by $\lambda/2$ phase

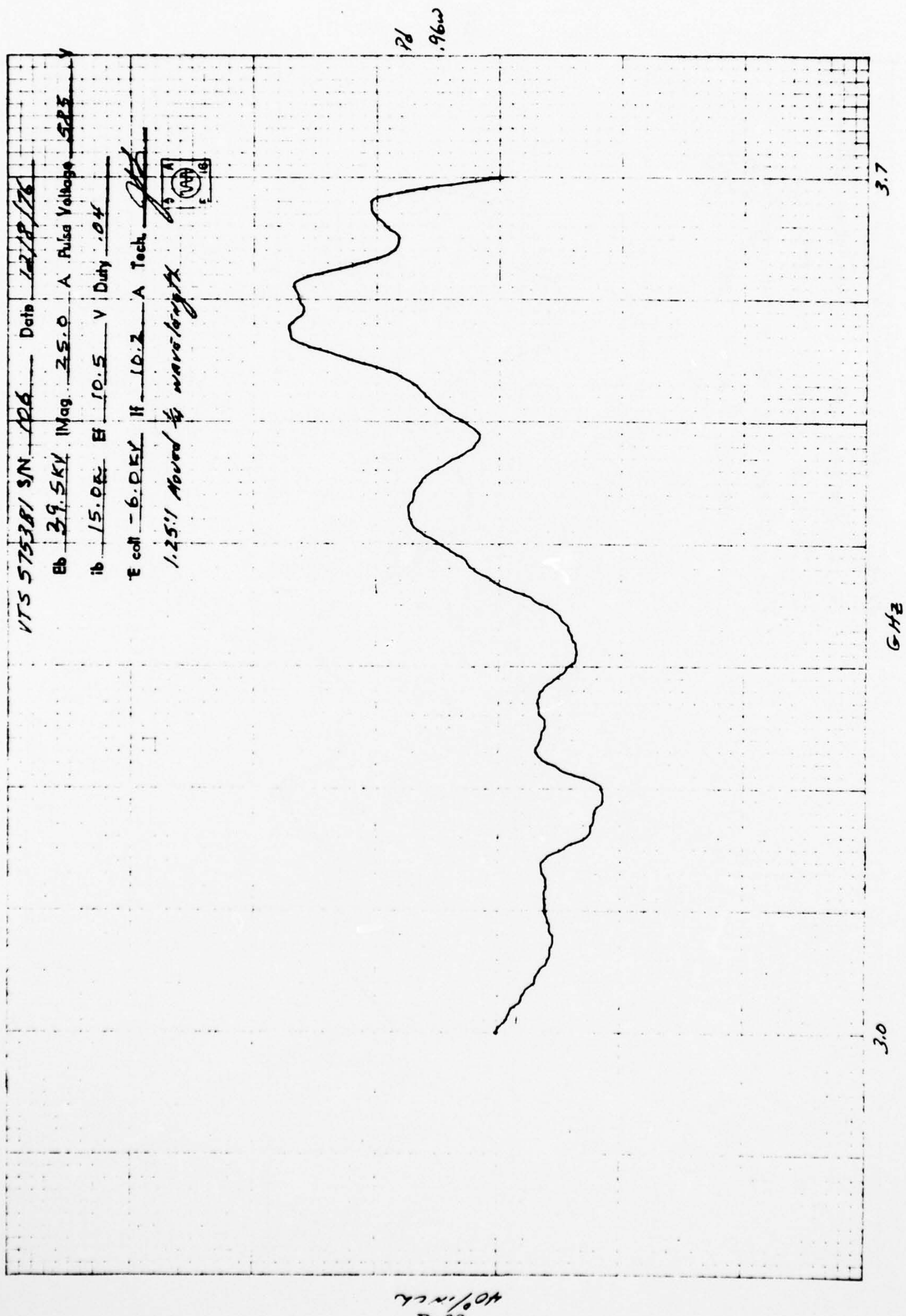

VTS5753BY S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 565 V
Ib 15.0a Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
1.25:1 moved 1/4 wavelength
180
150
120
90
60
30
Pokw (peak)
3.0
GHz
3.7
Pd
.96w

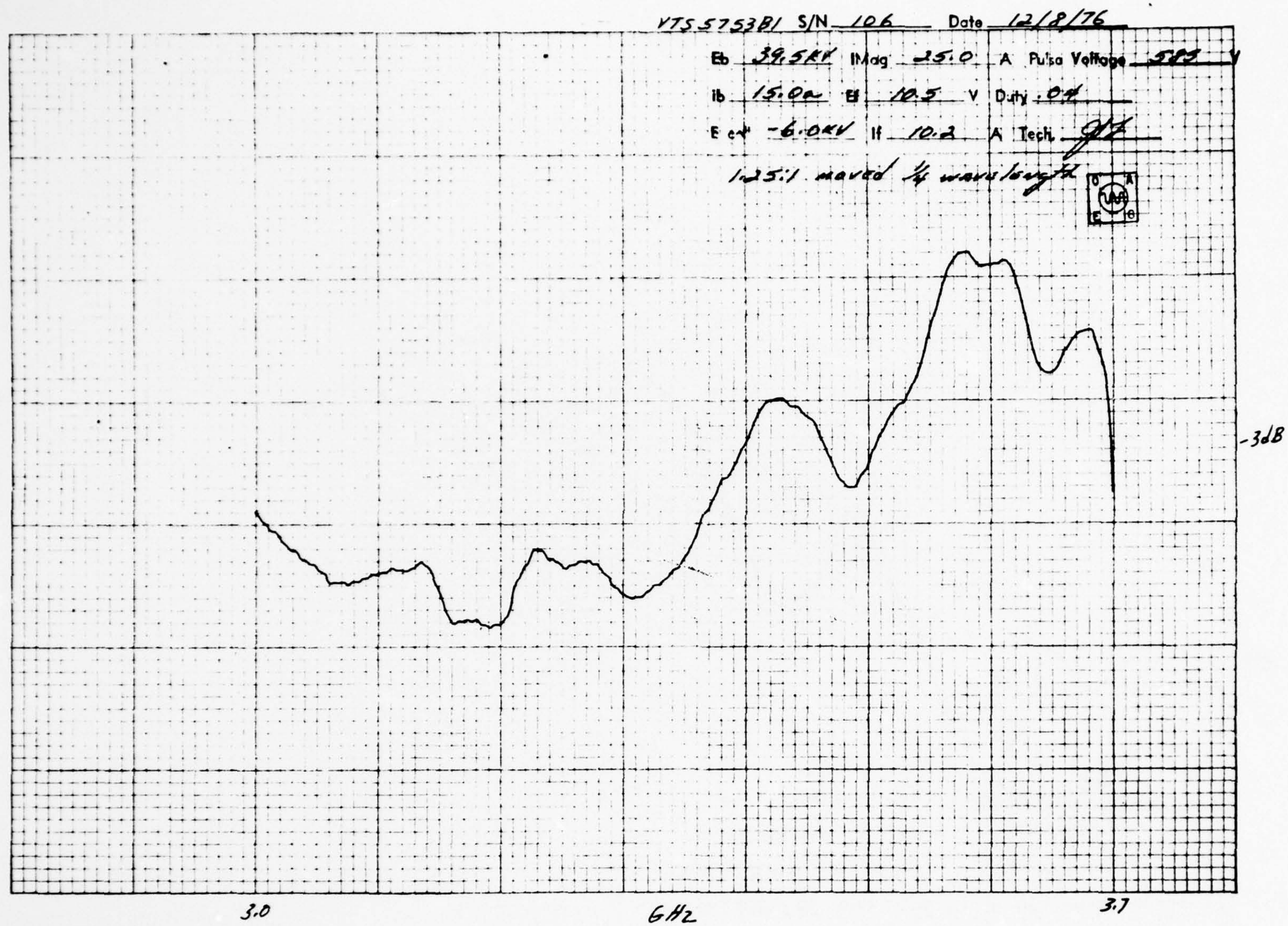

VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5 IMag 25.0 A Pulse Voltage V
ib 15.0A Ef 10.5 V
E coll -6.0KV If 10.2 A Tech.
1.25:1 moved 1/4 wave length
-3dB
+3dB
3.0
3.7
GHz
180
150
120
90
60
30
Po kw (peak)


VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMin 25.0 A Pulse Voltage 585 V
ib 15.0A Ef 10.5 V Duty .04
E coll -8.0KV If 10.2 A Tech.
1.25:1 moved 1/4 wavelength
150
120
90
60
30
Power (Peak)
-6dB
-9dB
-12dB
3.0
GHz
3.7


VTS5753B1 S/N 106 Date 12/8/76
Eb 35.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0A Ef 10.5 V Duty .01
E coll -6.0KV If 10.2 A Tech.
1.25:1 Moved 1/4 wavelength
+3dB
3.0
GHz
3.7

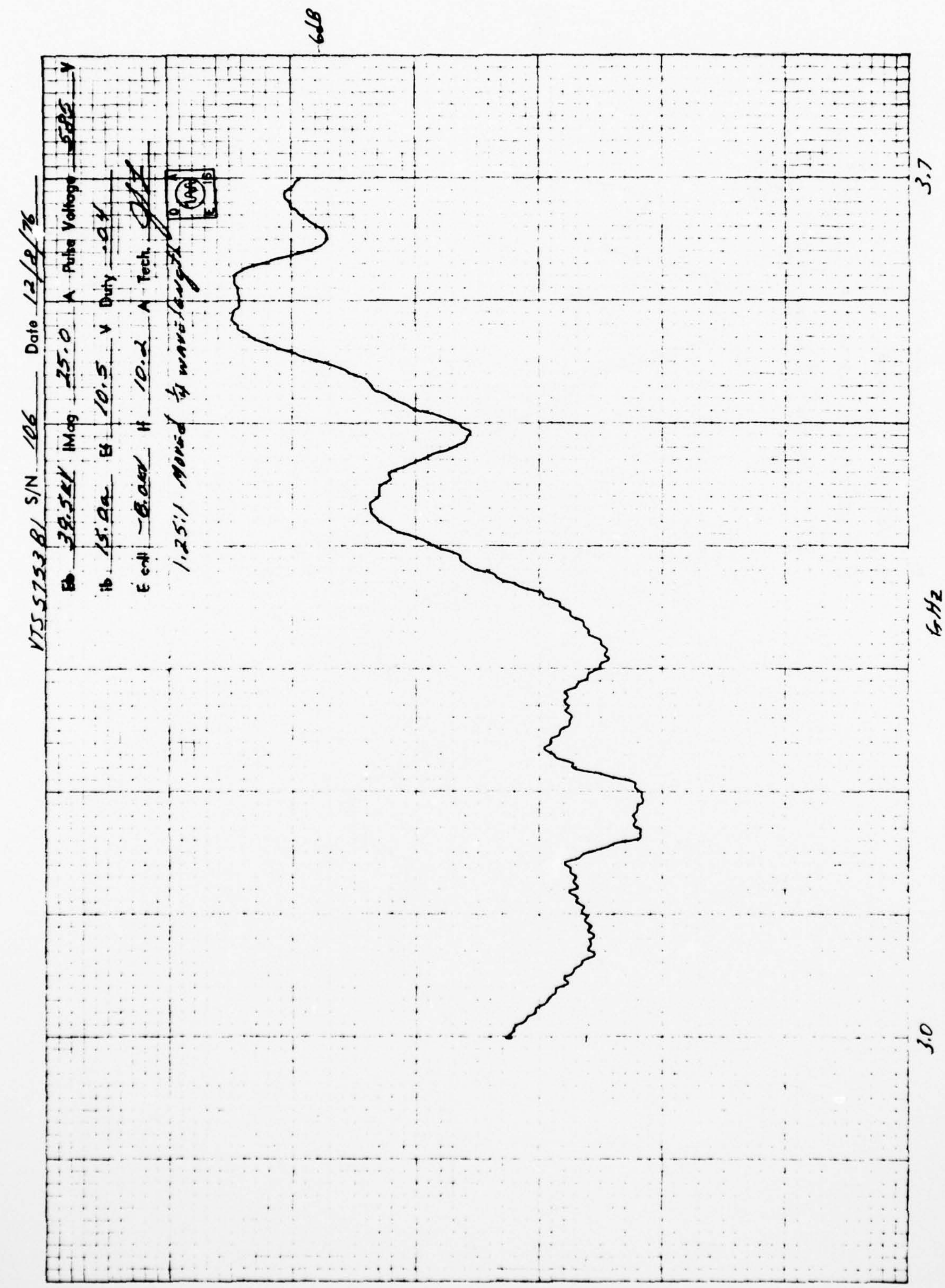
40°/inch

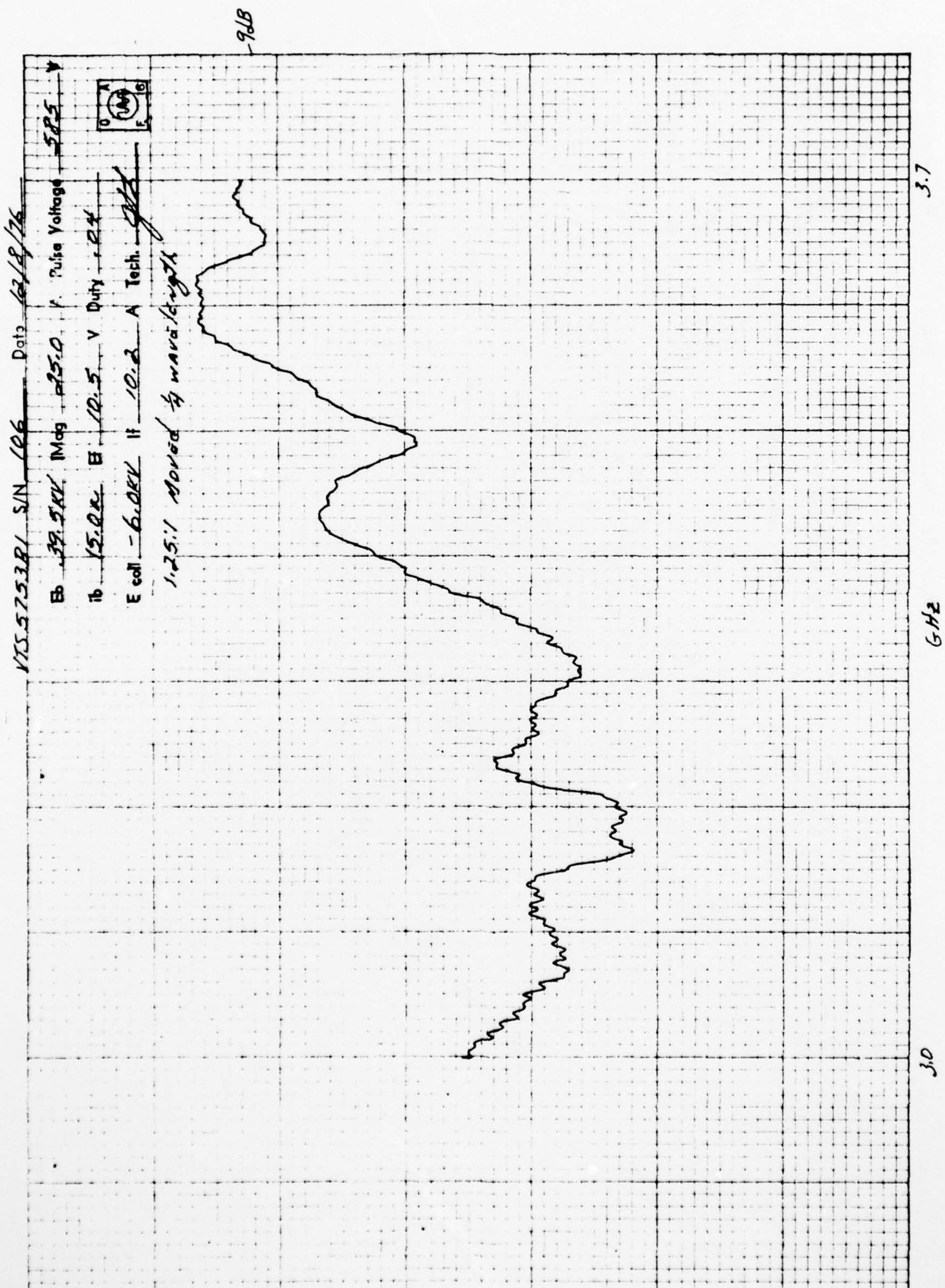

VTS 575381 S/N 106 Date 12/8/76
Eb 29.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0E Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech
1.25:1 Moved 1/4 wavelength
78
.96w
3.0
3.7
GHz

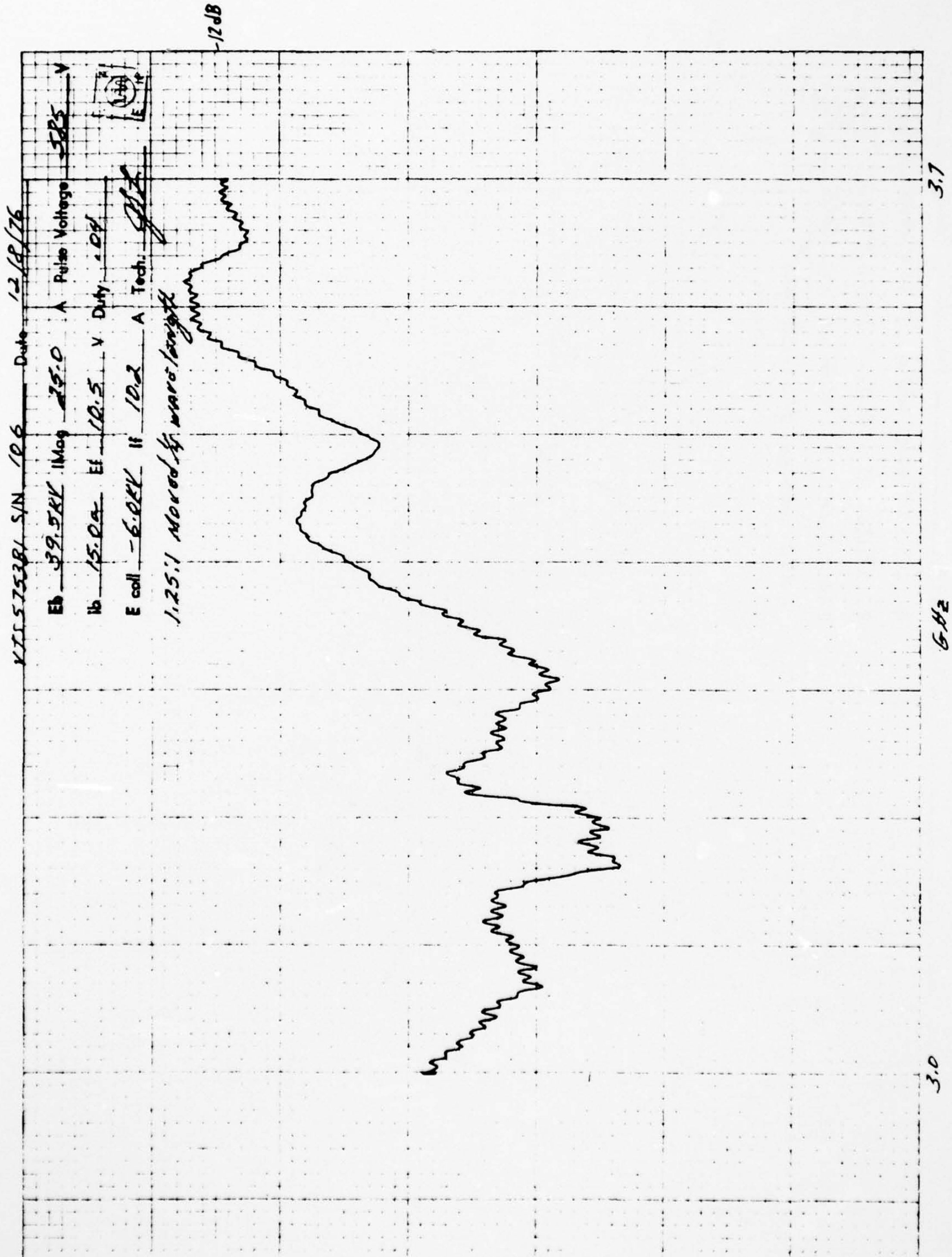


VTS 5753B1 S/N 106 Date 12/8/76
Eb 39.5KV IMag 25.0 A Pulse Voltage V
Ib 15.0a Ef 10.5 V Duty .04
E c-t -6.0KV If 10.2 A Tech
1.25:1 moved ¼ wavelength
-3dB
3.0
GHz
3.7

40%/inch

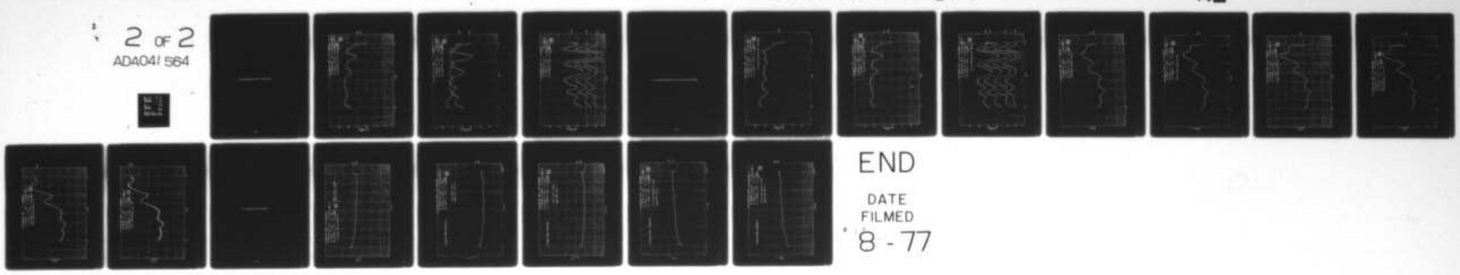

VTS5753B1 S/N 106 Date 12/8/76
Eb 39.5kV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .01
E coll -8.0kV H 10.2 A Tech.
1.25:1 Moved 1/4 wavelength
6dB
3.0
3.7
GHz


VTS-5753B1 S/N 106 Date 12/8/76
Eb 39.5KV Mag 25.0 V Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .024
E coll -6.0KV If 10.2 A Tech.
1.25:1 Moved 1/4 wavelength
9dB
3.7
GHz
3.0
40°/inch


S/N 106
Date 12/8/76
Eb 39.5KV
IMag 25.0 A
Pulse Voltage
Ib 15.0a
Ef 10.5 V
Duty .01
E coll -6.0KV
If 10.2 A
Tech.
-12dB
3.1
GHz
3.0

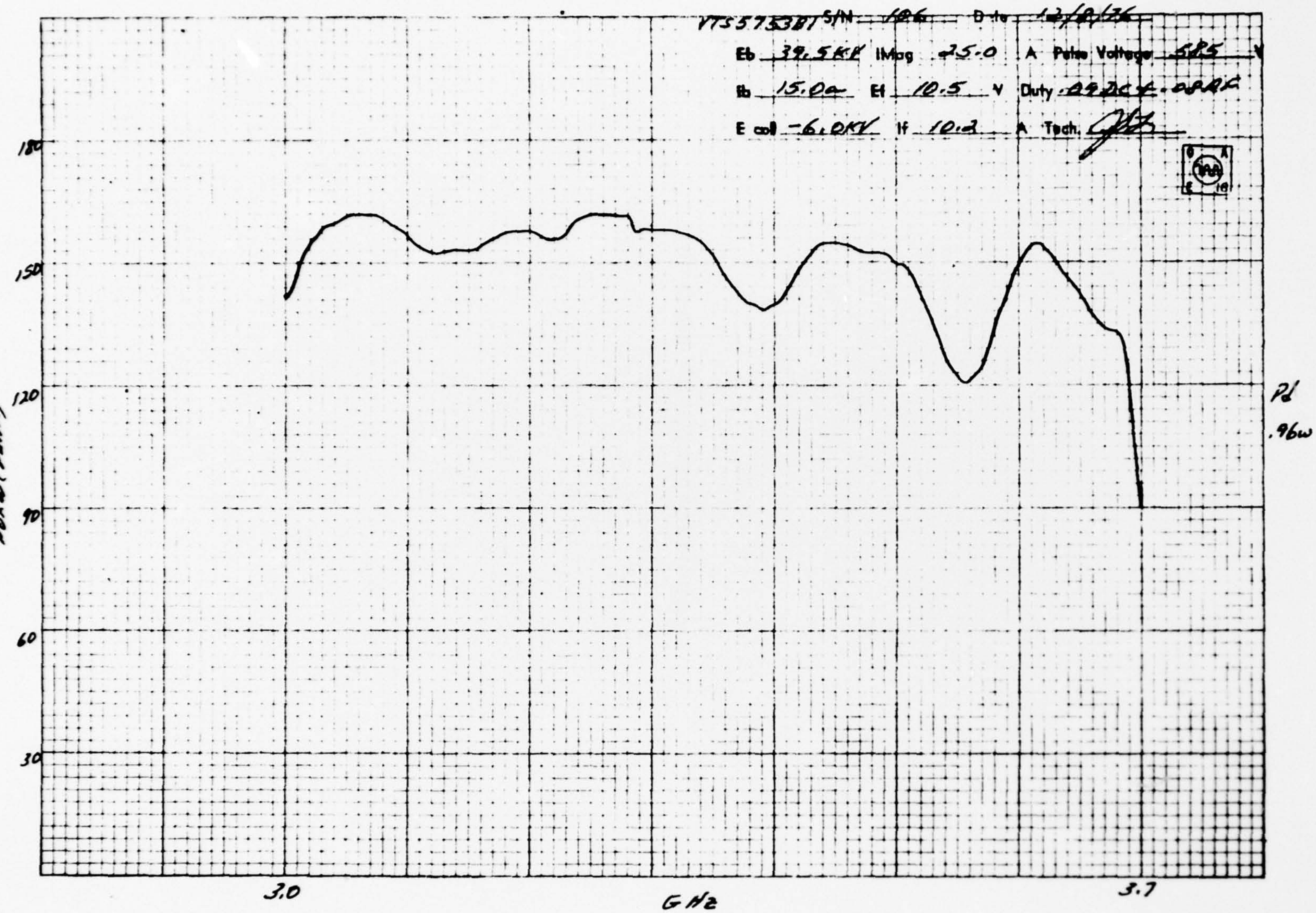
AD-A041 564 VARIAN ASSOCIATES PALO ALTO CALIF PALO ALTO MICROWAV--ETC F/G 9/5
EXTENDED BANDWIDTH VTS-5753B1 COUPLED CAVITY TRAVELING WAVE TUB--ETC(U)
JUN 77 R GIEBLER F30602-76-C-0232
UNCLASSIFIED RADC-TR-77-174 NL

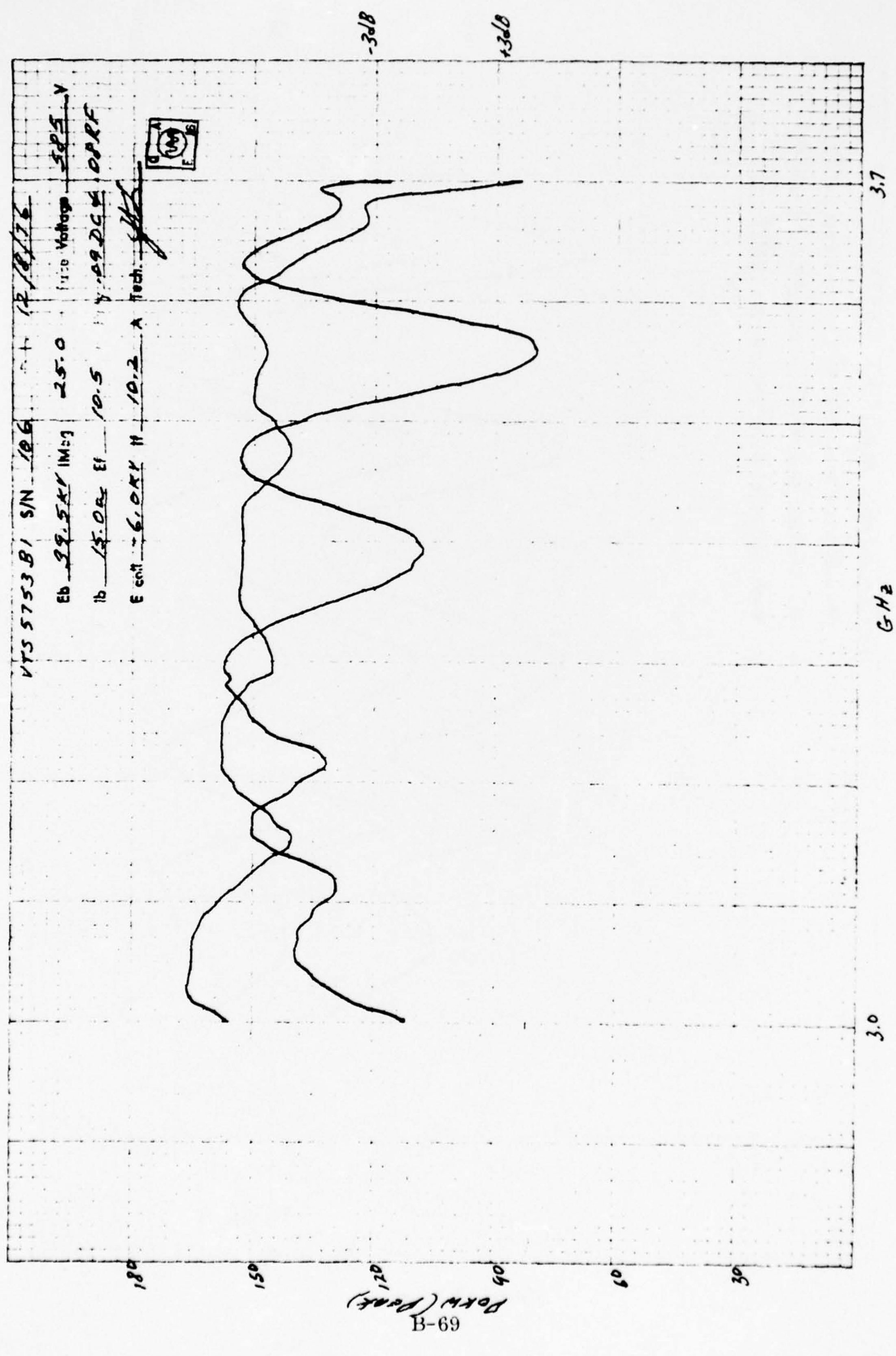
2 OF 2
ADA041 564

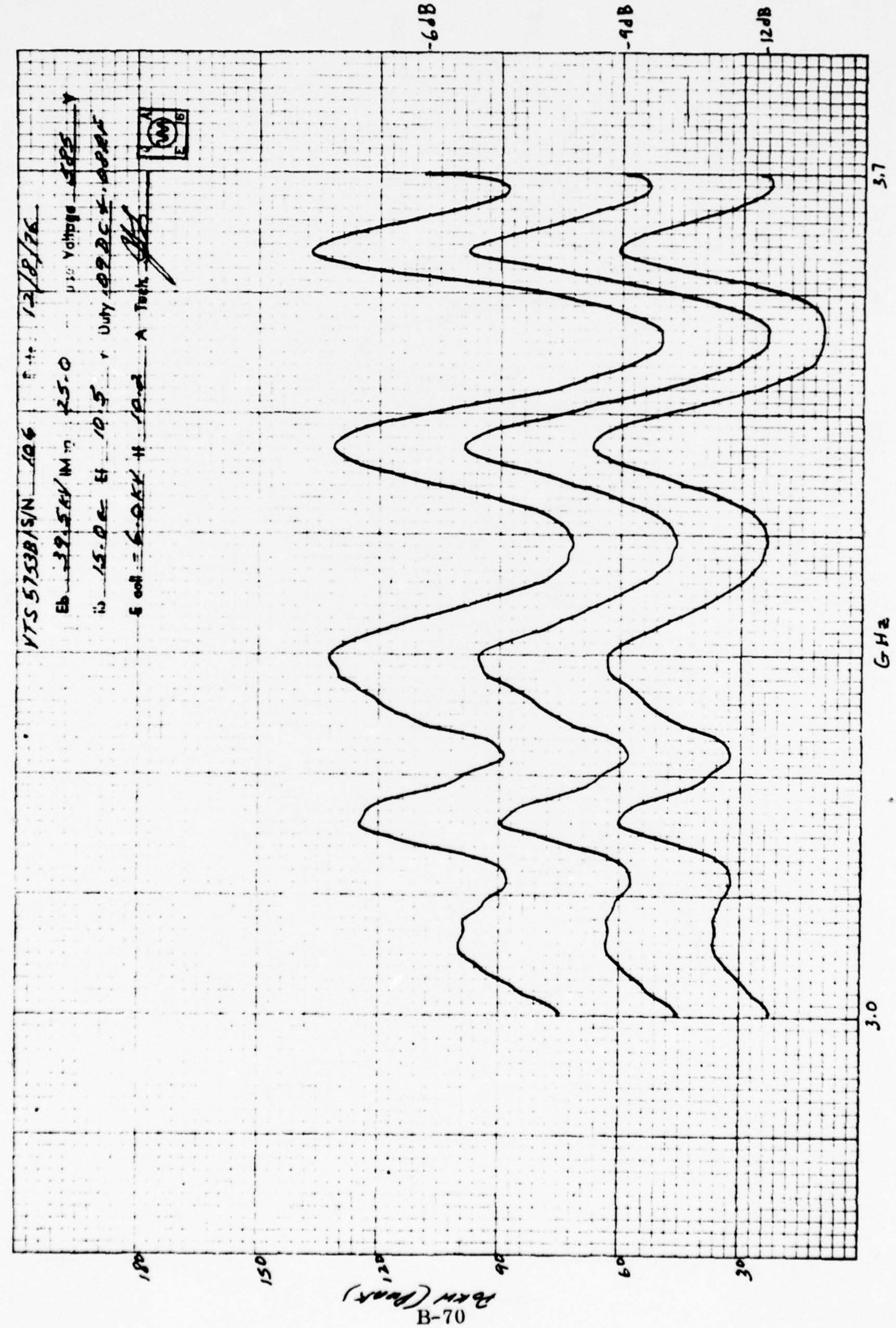


END
DATE
FILMED
8 - 77

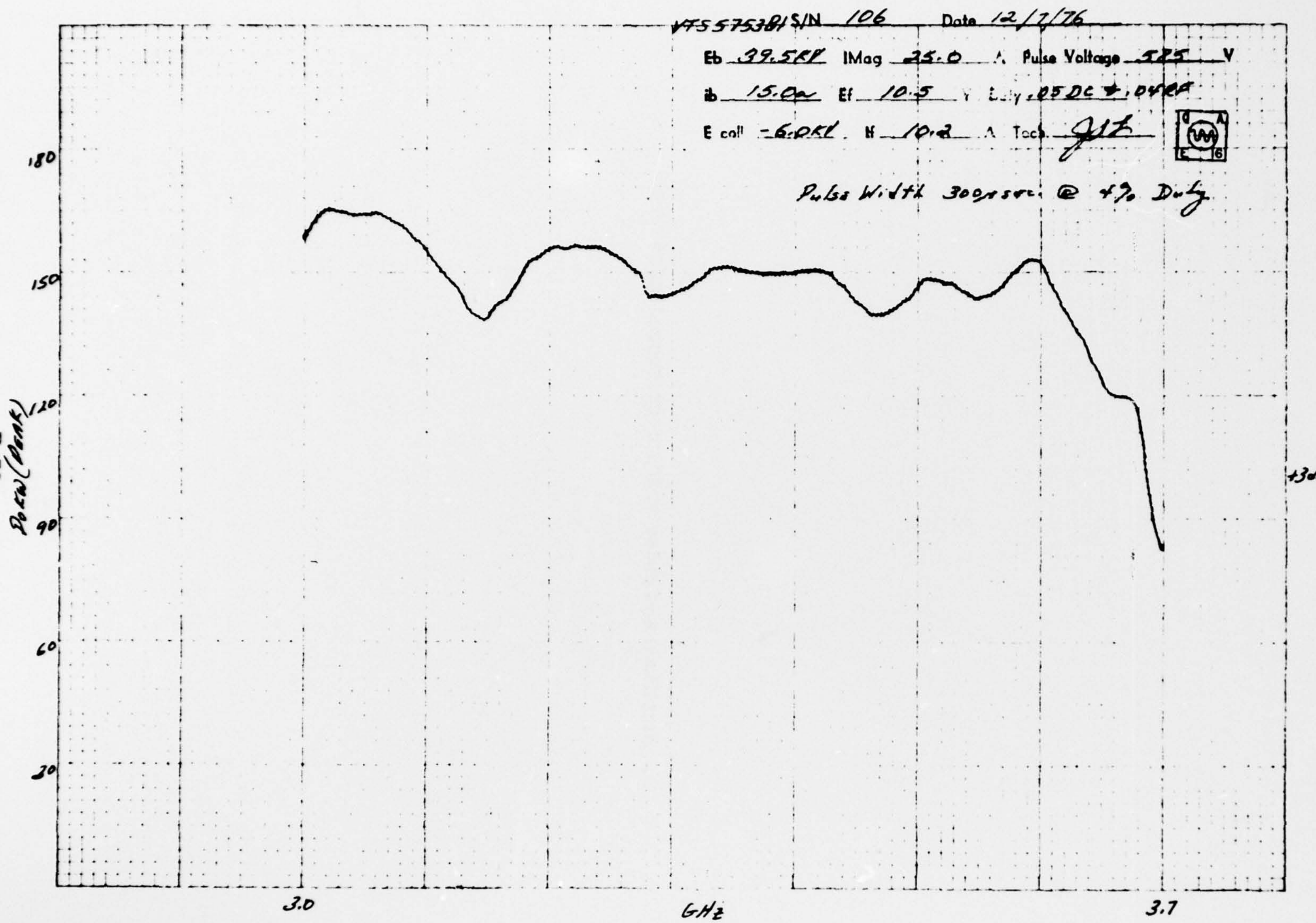
8. Amplitude and phase at 8% duty factor

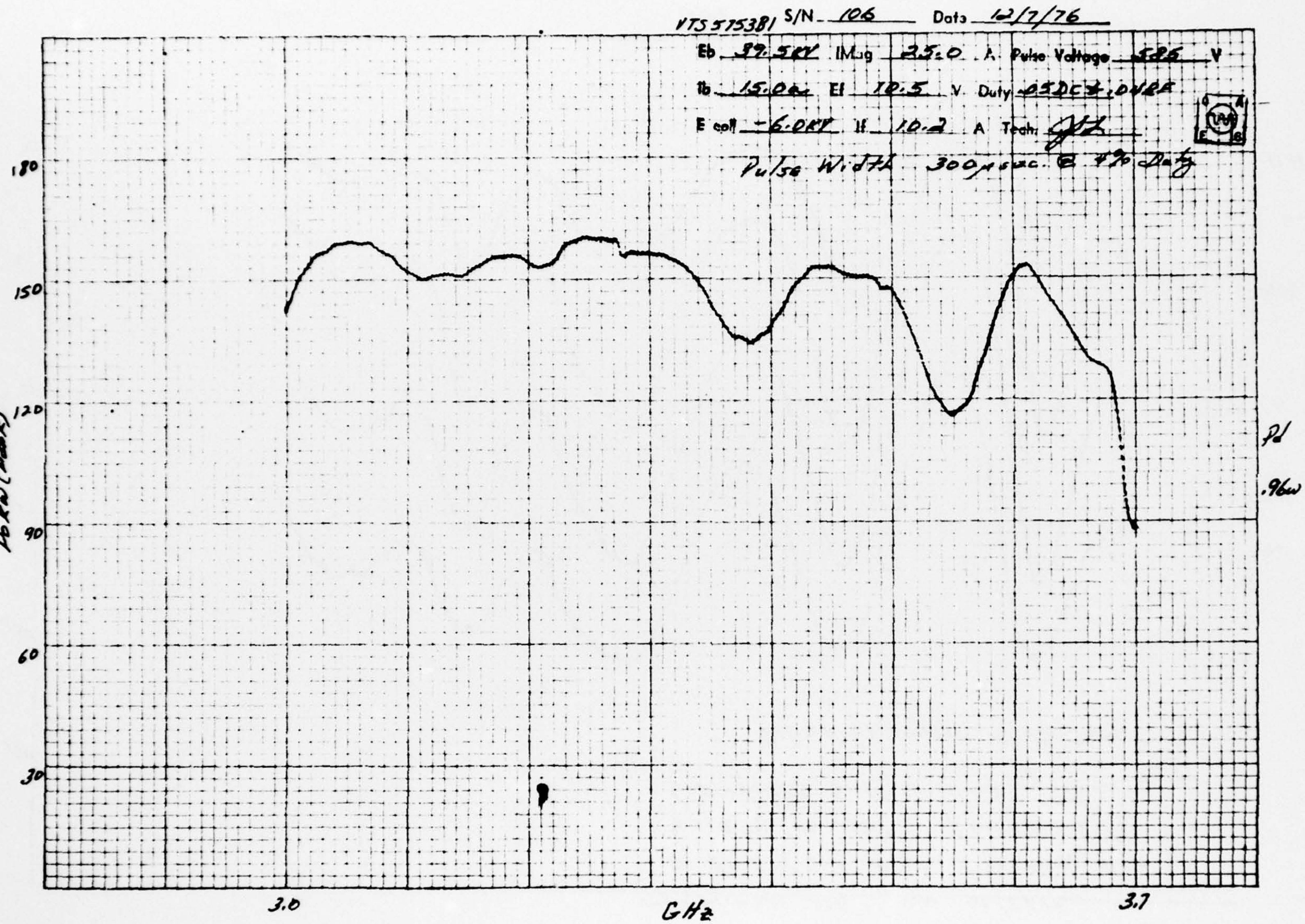

VTS5753B1 S/N 106 Date
Eb 39.5KV IMag 25.0 A Pulse Voltage
Ib 15.0a Ef 10.5 V Duty
E coll -6.0KV If 10.2 A Tech.
180
150
120
90
60
30
Po KW (Peak)
3.0
GHz
3.7
Pd
.96w

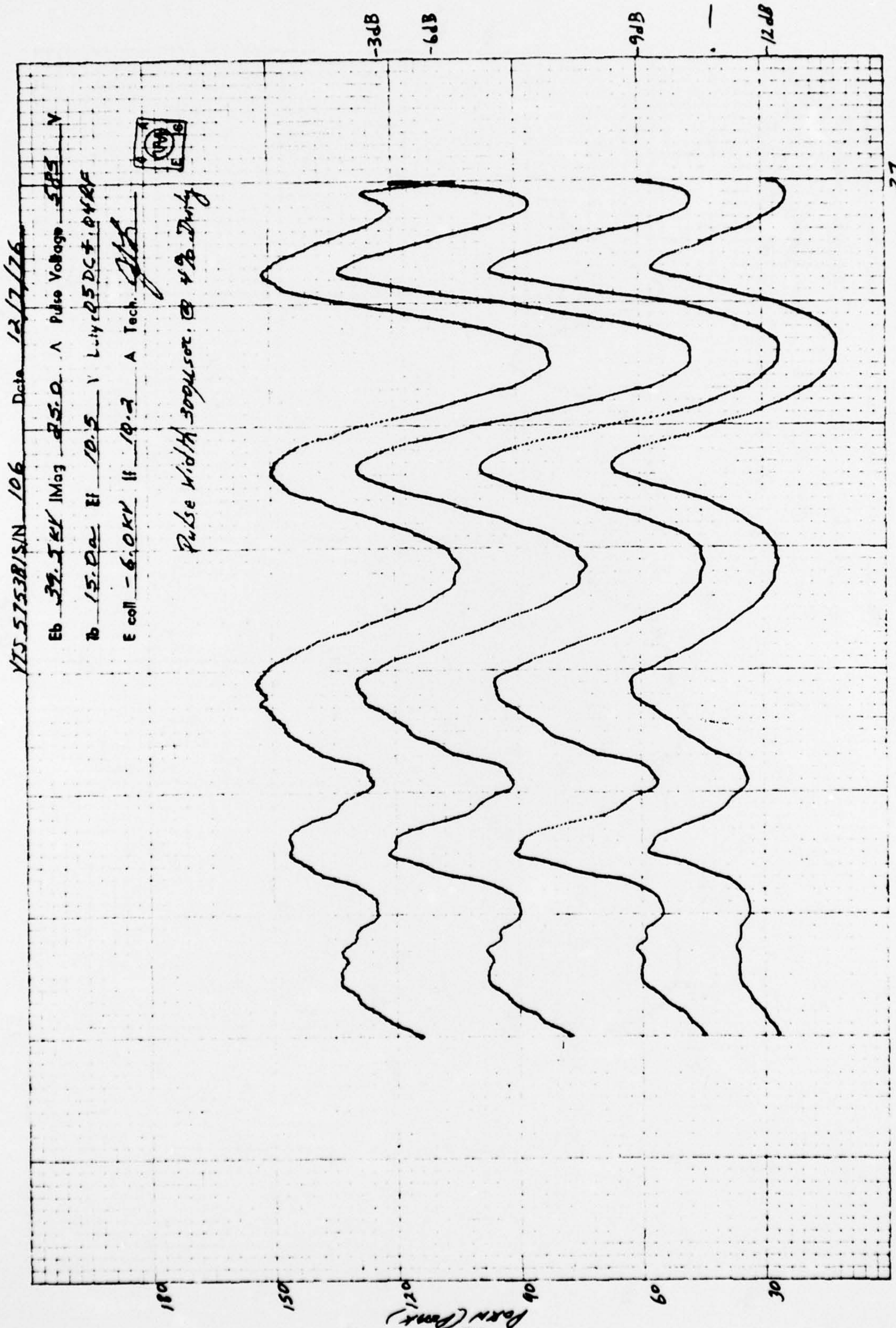

VTS 5753 B1 S/N 106
12/18/76
Eb 29.5 KV
25.0
Voltage 585 V
Ib 15.0A
10.5
E coll -6.0 KV
10.2 A
Tech.
-3dB
+3dB
3.0
3.7
GHz
180
150
120
90
60
30
Pokw (Peak)


-6dB
-9dB
-12dB
3.0
3.7
GHz
180
150
120
90
60
30

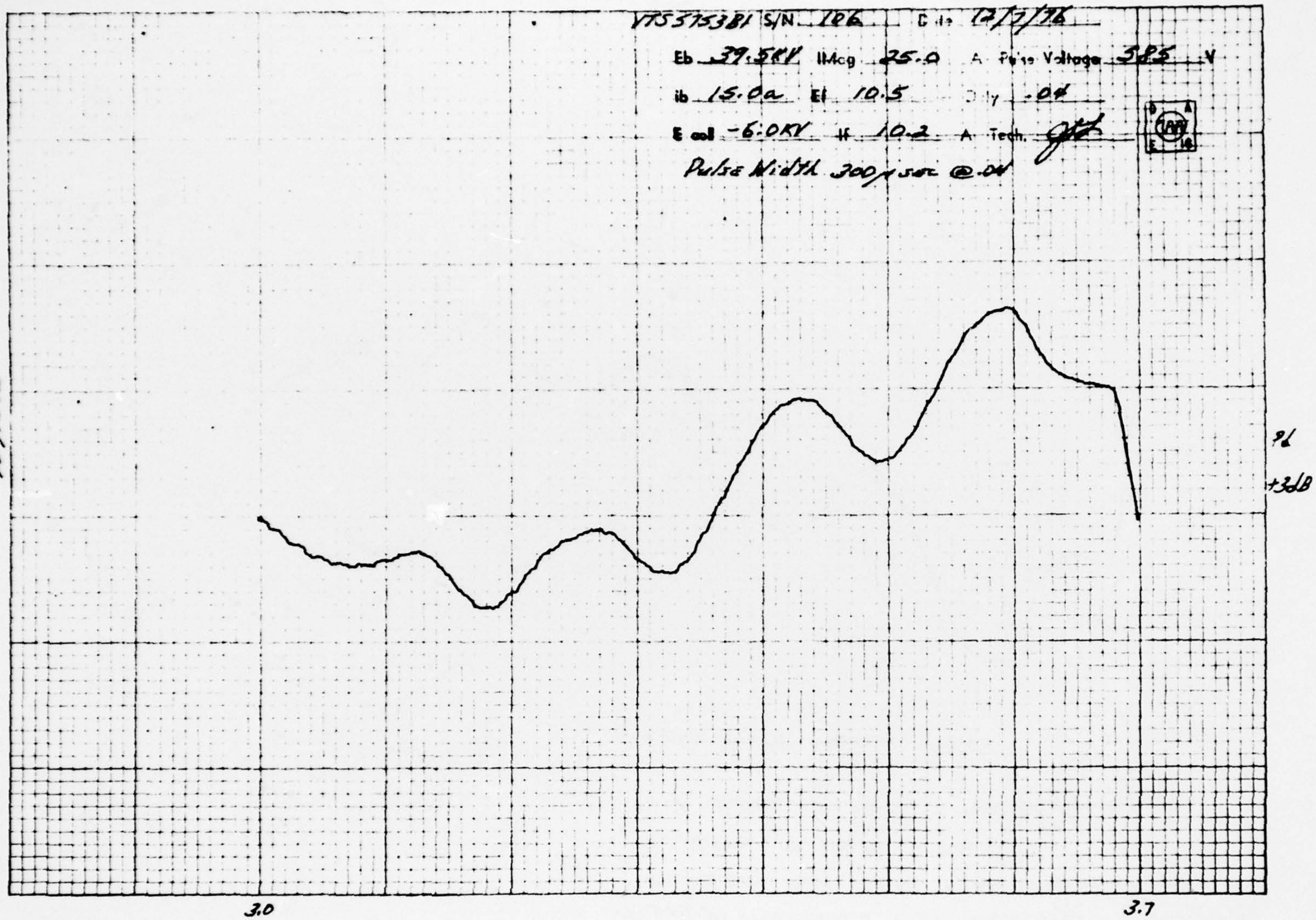
9. Amplitude and phase at 300 microsecond pulse length

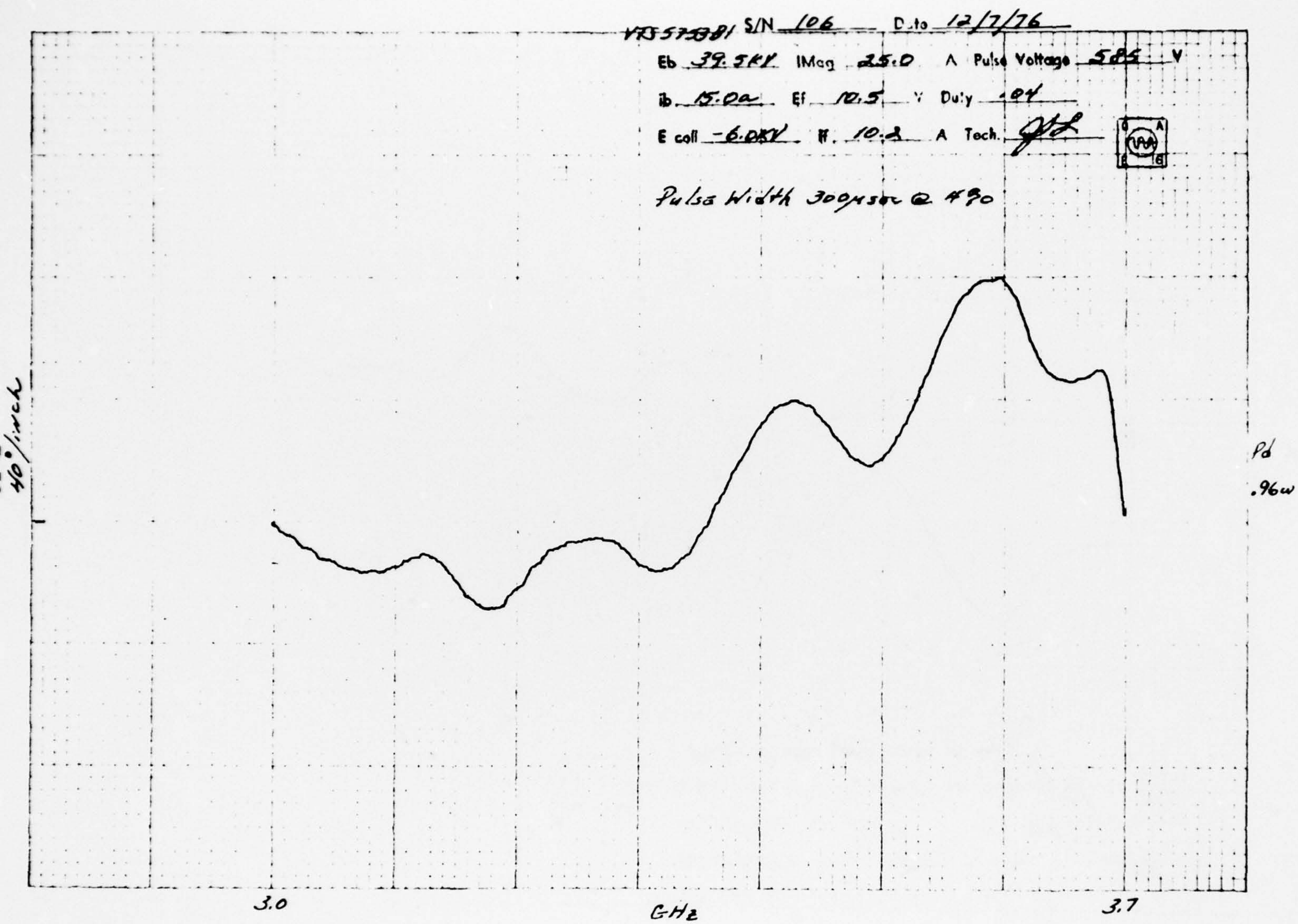

VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 525 V
ib 15.0a Ef 10.5 V Duty .05DC + .04RF
E coll -6.0KV If 10.2 A Tech
Pulse Width 300nsec @ 4% Duty
180
150
120
90
60
30
Power (Peak)
3.0
GHz
3.7
+3dB

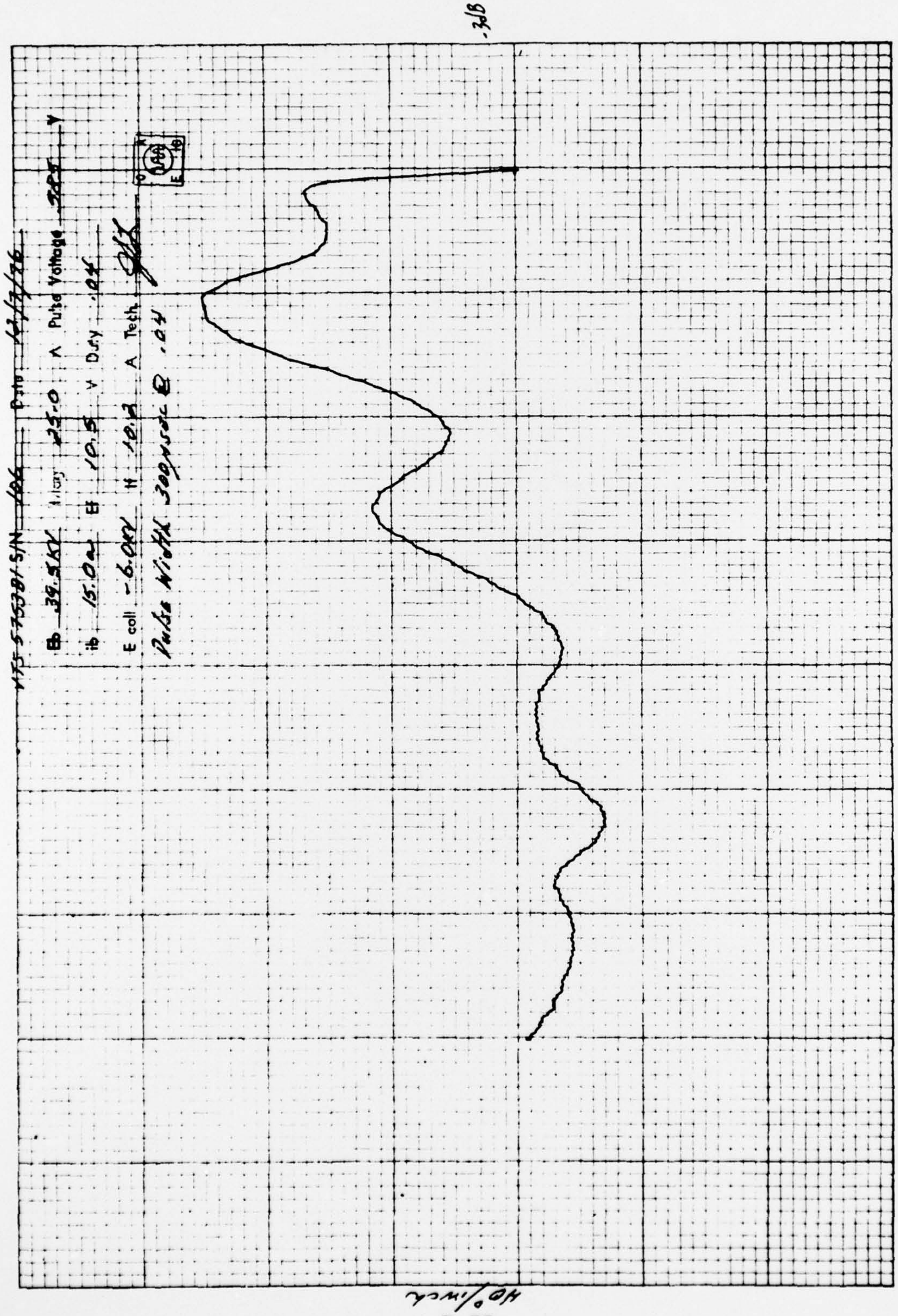

VTS 575381 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 586 V
Ib 15.0a EI 10.5 V Duty .05DC .04RF
E coll -6.0KV If 10.2 A Tech:
Pulse Width 300 μsec. @ 4% Duty
180
150
120
90
60
30
Po KW (Peak)
3.0
GHz
3.7
Pd
.96w

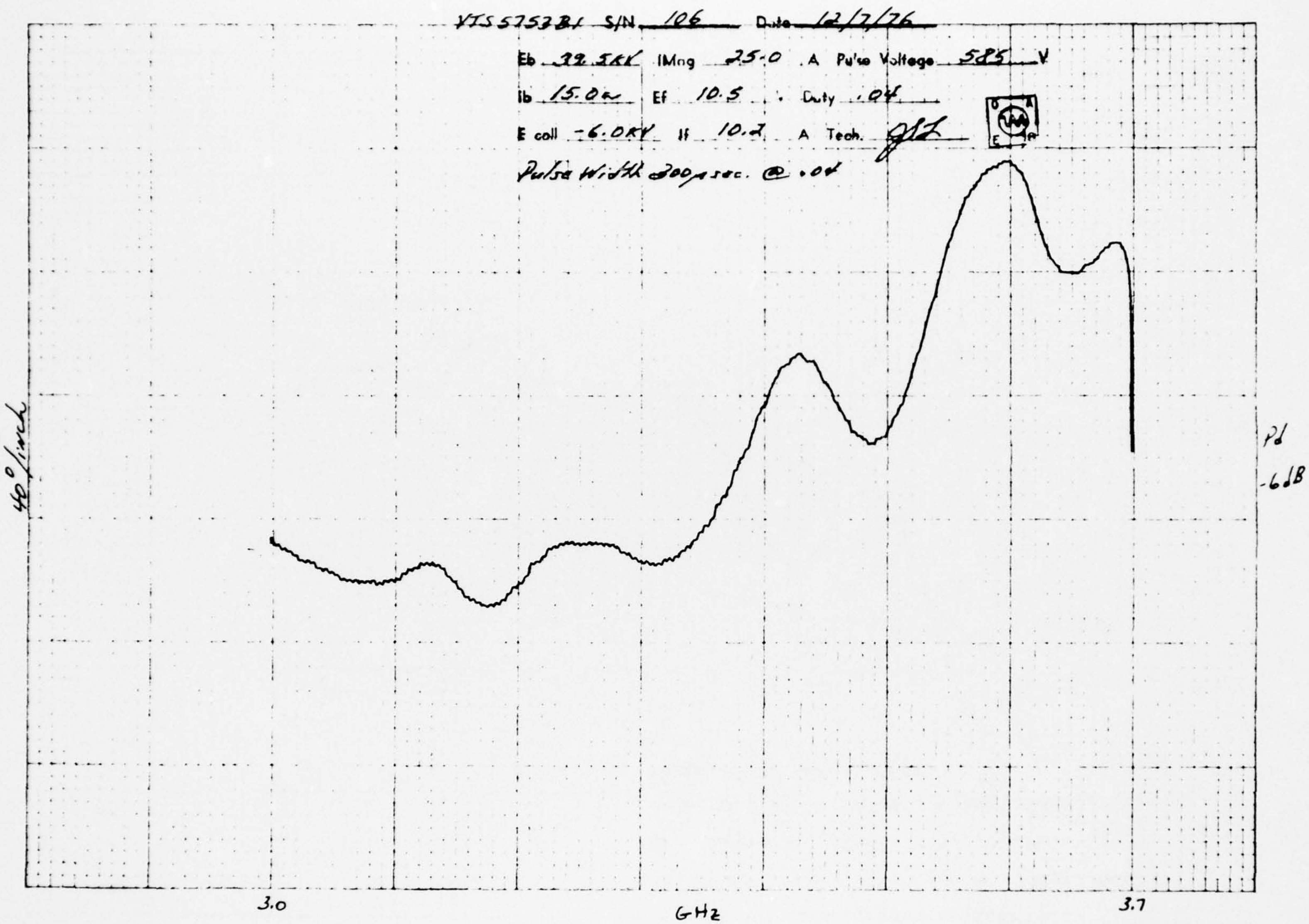


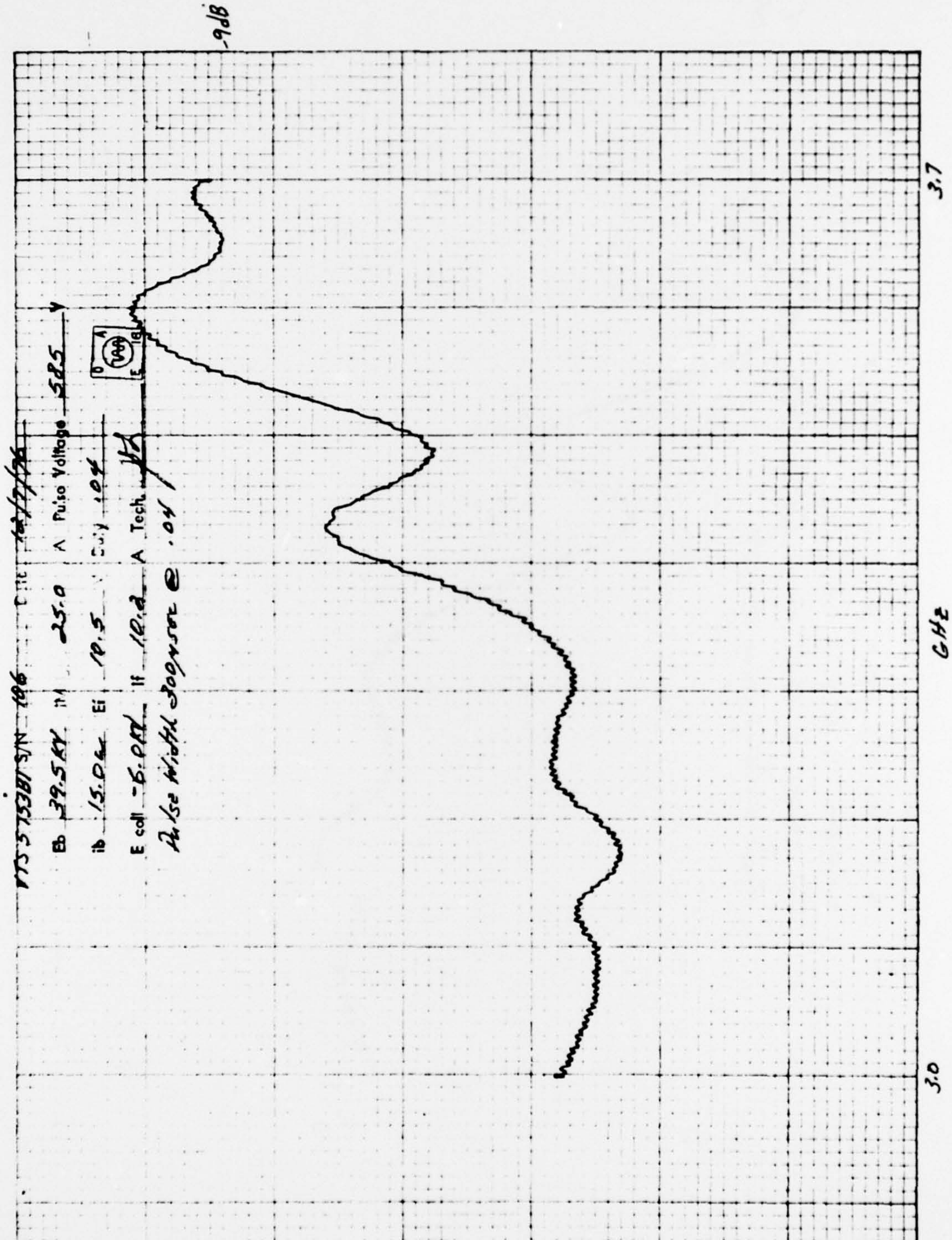
YTS 5753B S/N 106
Date 12/7/76
Eb 39.5KV
IMag 25.0
Pulse Voltage 585
Ib 15.0a
Ef 10.5
E coll -6.0KV
If 10.2
Tech.
Pulse Width 300μsec. @ 4% Duty
-3dB
-6dB
-9dB
-12dB
3.0
3.7
GHz
180
150
120
90
60
30

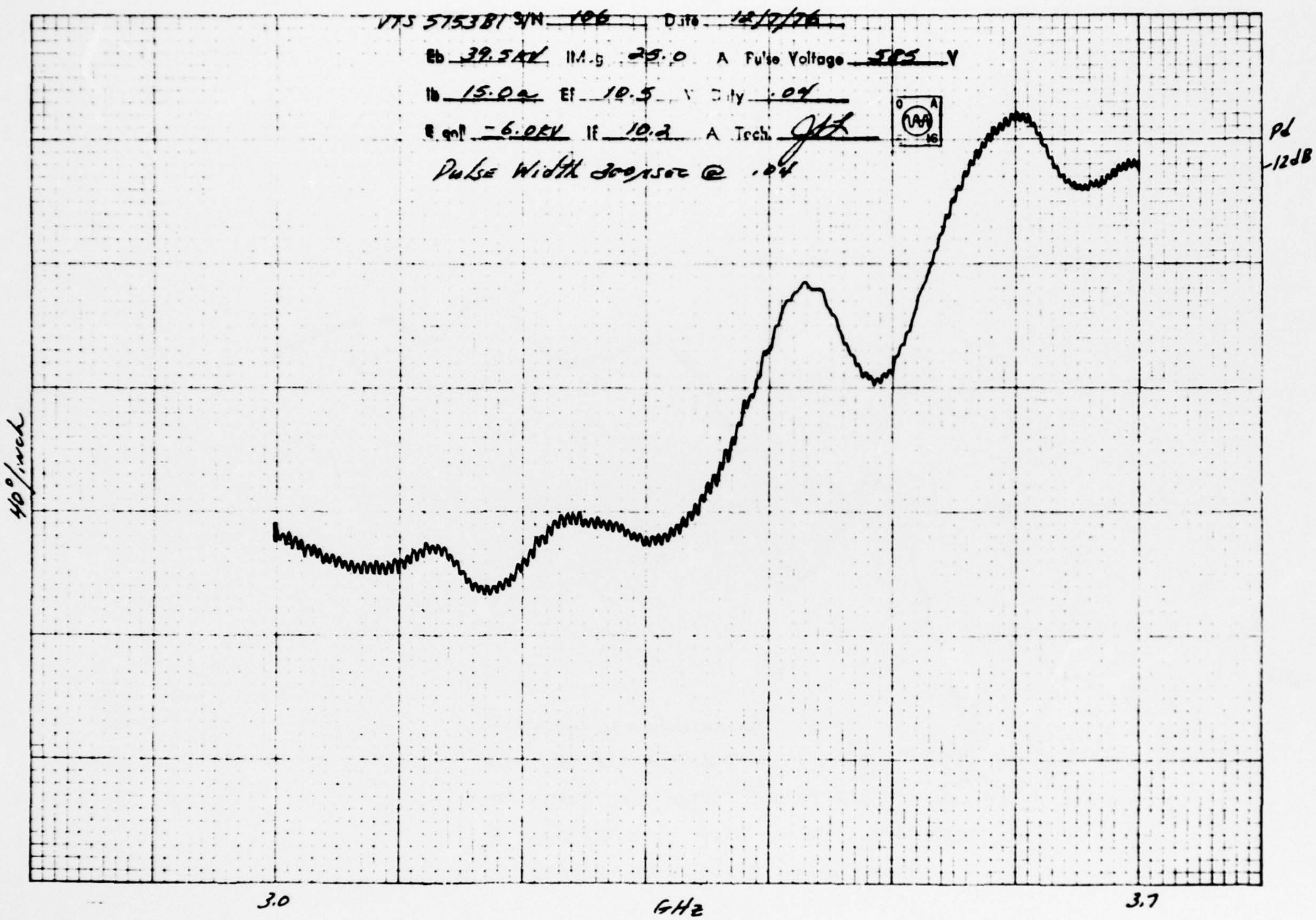

VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 385 V
ib 15.0a Ef 10.5 Duty .04
E coll -6.0KV If 10.2 A Tech.
Pulse Width 300 µsec @ .04
3.0
3.7
96
+3dB
40°/inch


VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
ib 15.0a Ef 10.5 V Duty .04
E coll -6.0KV If. 10.2 A Tech.
Pulse Width 300μsec @ 4%
Pd
.96w
3.0
GHz
3.7

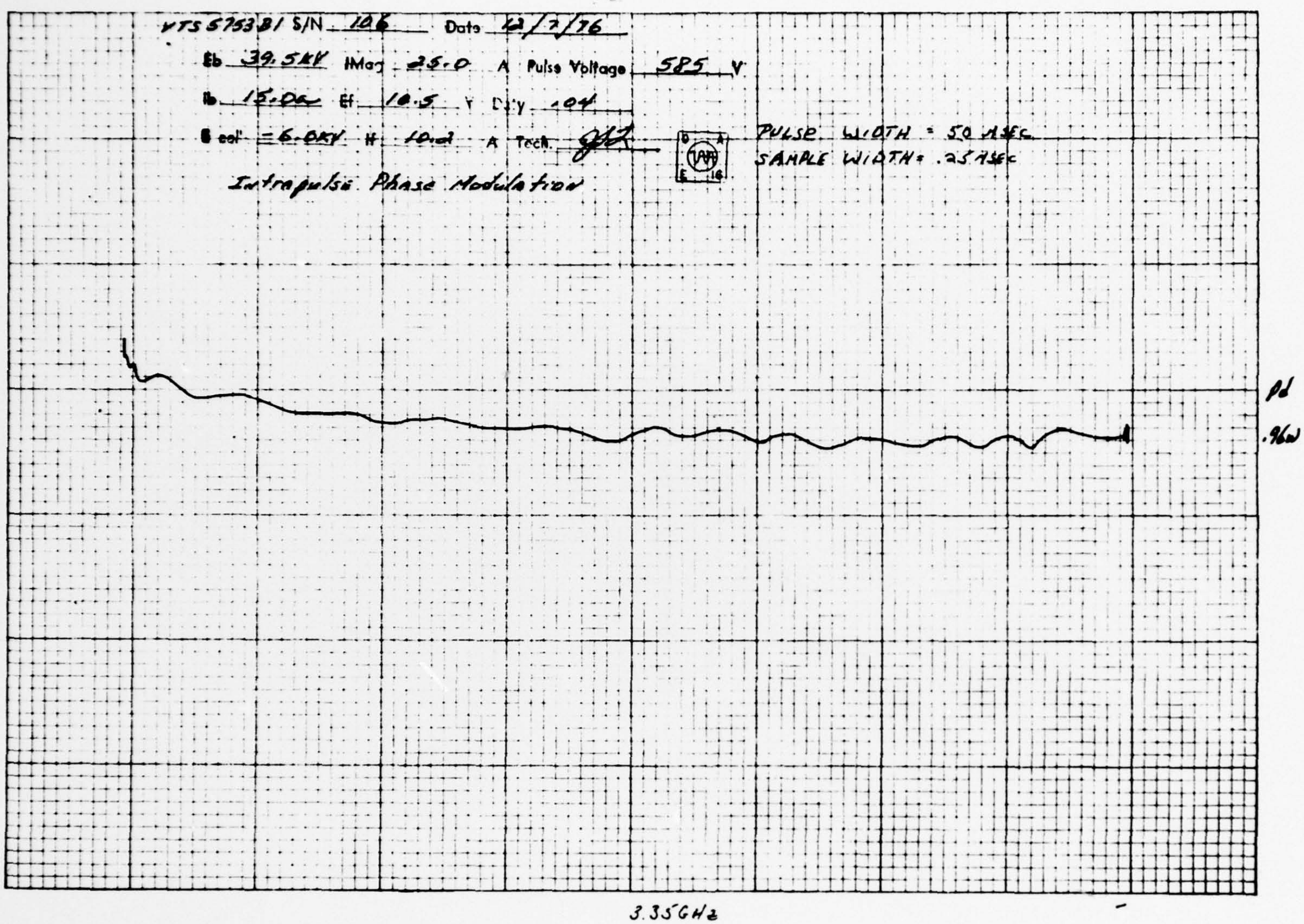

S/N 106
Date 12/3/76
Eb 39.5KV
I.Body 25.0 A
Pulse Voltage
ib 15.0a
Ef 10.5 V
Duty .04
E coll -6.0KV
H 10.7 A
Tech
Pulse Width 300μsec @ .04
GHz
3.0
3.1


VTS5753B1 S/N 106 Date 12/7/76
Eb 32.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 . Duty .04
E coll -6.0KV If 10.2 A Tech. JJL
Pulse Width 300μsec. @ .04
40°/inch
Pd
-6dB
3.0
GHz
3.7

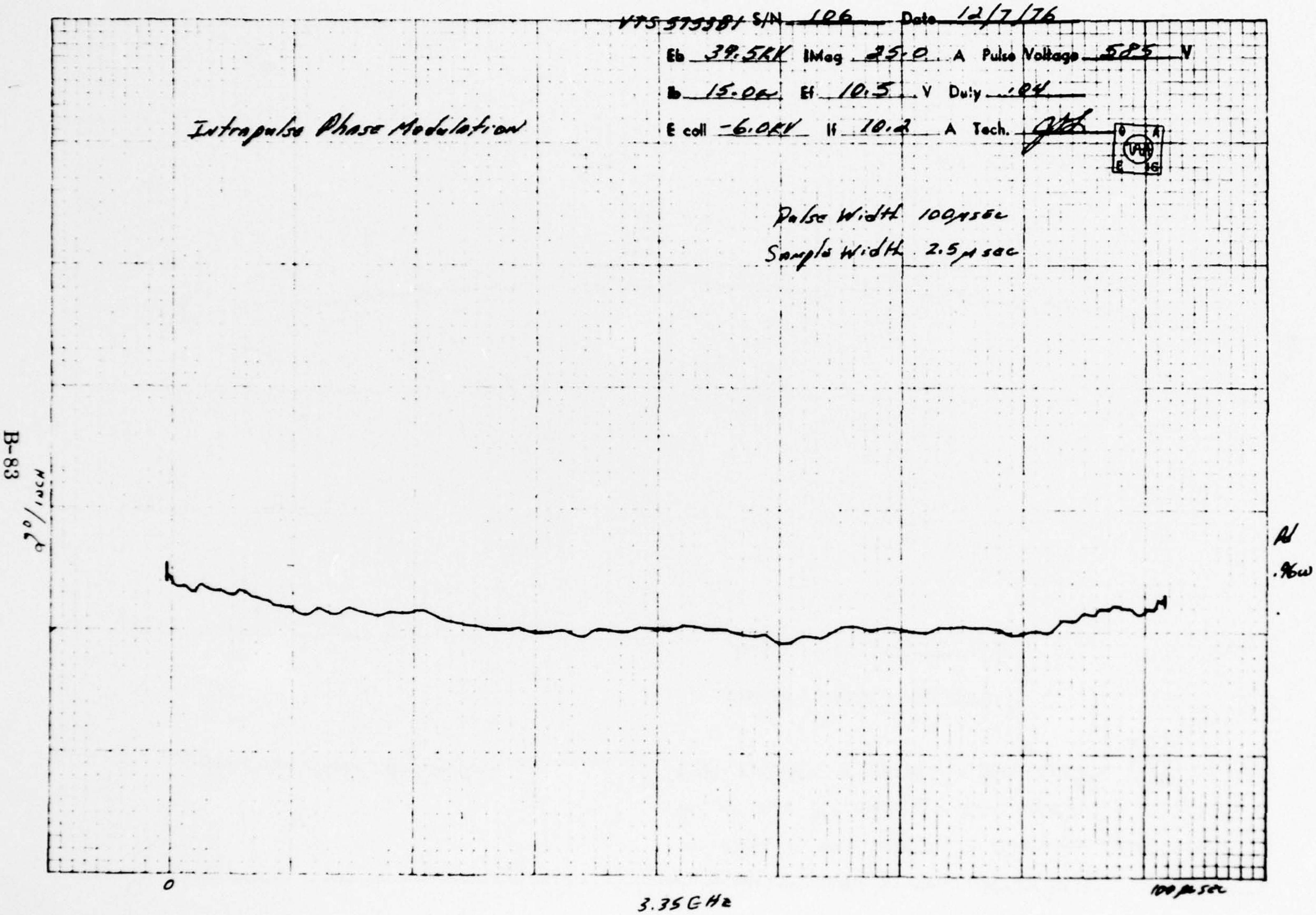

-9dB
3.7
GHz
3.0
Pulse Voltage
Tech
Pulse Width

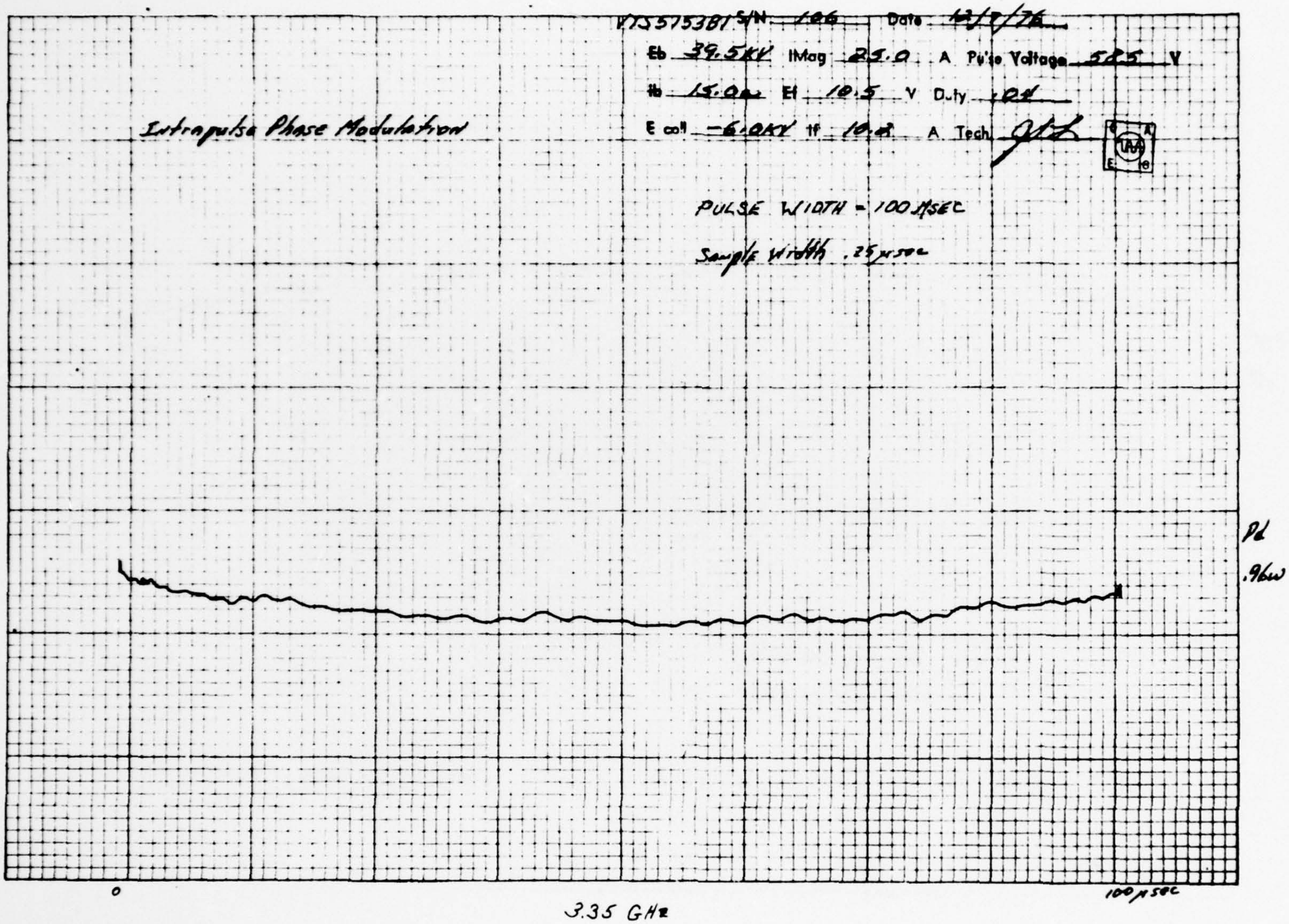

VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IM.g 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .04
E gnd -6.0KV If 10.2 A Tech
Pulse Width 200µsec @ .04
Pd
-12dB
40°/inch
3.0
GHz
3.7

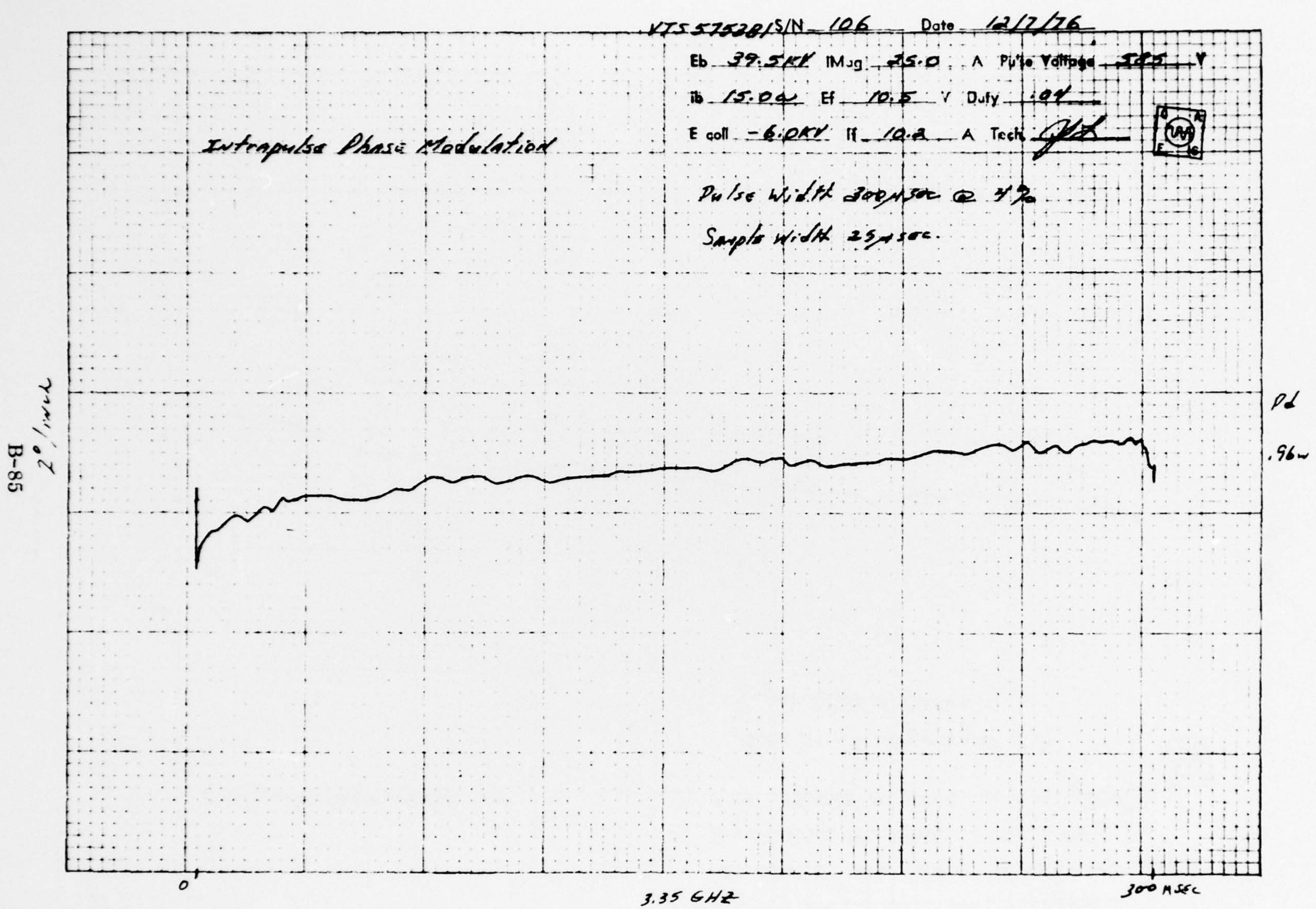
10. Intrapulse phase modulation

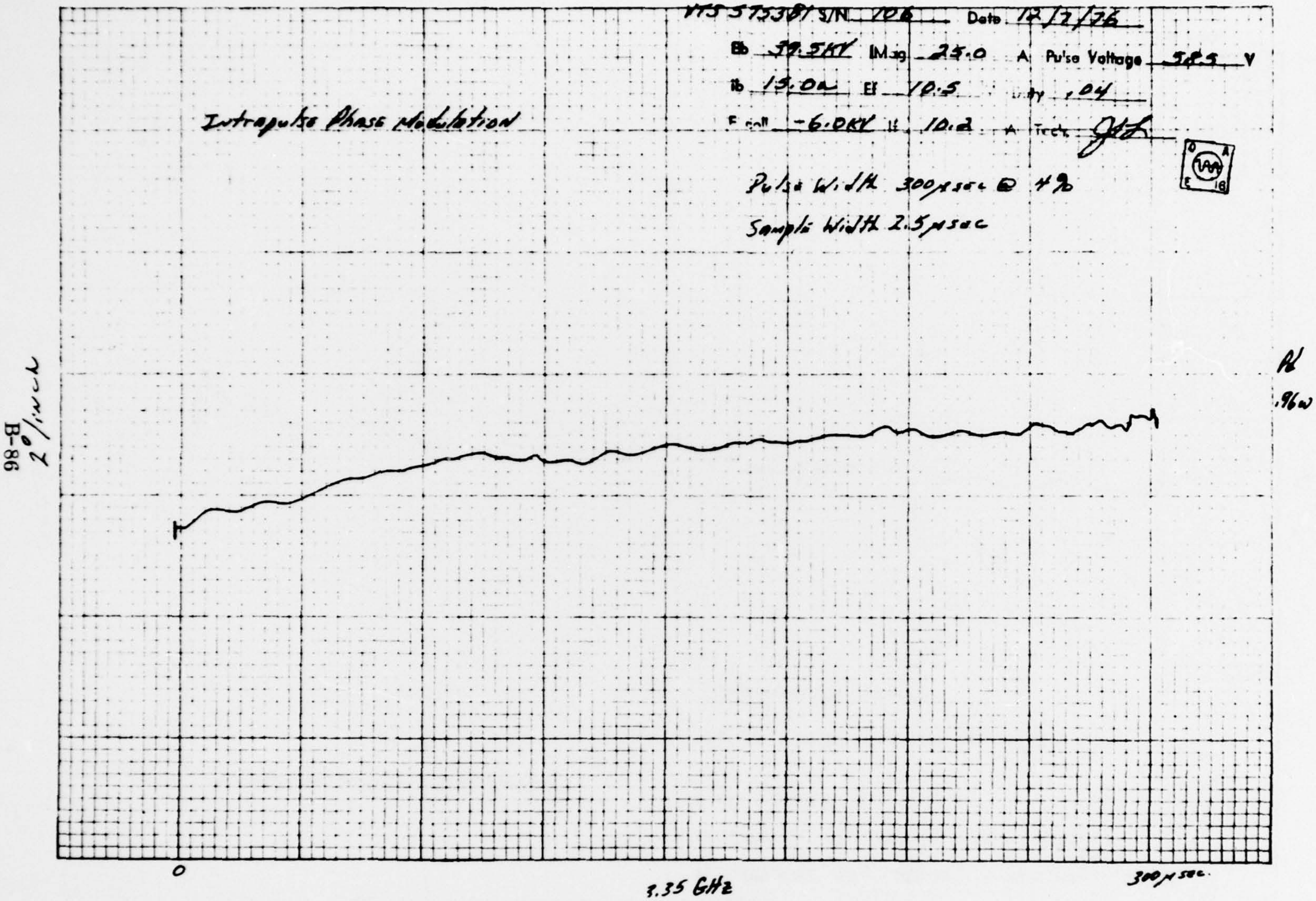

VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0a Ef 10.5 V Duty .04
E col =6.0KV If 10.2 A Tech.
Intrapulse Phase Modulation
PULSE WIDTH = 50 μSEC
SAMPLE WIDTH = .25 μSEC
Pd
.96w
3.35GHz

2°/INCH


VTS 5755B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech.
Intrapulse Phase Modulation
Pulse Width 100μsec
Sample Width 2.5μsec
0
3.35GHz
100μsec
.96w
20°/INCH


Intrapulse Phase Modulation
VTS5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 585 V
Ib 15.0A Ef 10.5 V Duty .01
E coll -6.0KV If 10.8 A Tech
PULSE WIDTH = 100 μSEC
Sample Width .25 μsec
Pd
.96w
2°/inch
0
100 μsec
3.35 GHz


VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage V
Ib 15.0A Ef 10.5 V Duty .04
E coll -6.0KV If 10.2 A Tech
Intrapulse Phase Modulation
Pulse Width 300μsec @ 4%
Sample Width 25μsec.
Pd
.96w
0
3.35 GHz
300 μSEC
2°/inch


VTS 5753B1 S/N 106 Date 12/7/76
Eb 39.5KV IMag 25.0 A Pulse Voltage 58.5 V
Ib 13.0A Ef 10.5 .04
E coll -6.0KV If 10.2 A Tech.
Intrapulse Phase Modulation
Pulse Width 300 μsec @ 4%
Sample Width 2.5 μsec
.96w
0
3.35 GHz
300 μsec.
2°/inch